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Revision of *Saalmulleria* Mabille, 1891 (Lepidoptera, Metarbelidae) from Madagascar with the description of three new genera and fifteen new species

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Abstract

This is the first publication of any genus of Metarbelidae Strand, 1909 for Madagascar since 1891. Here, the genus *Saalmulleria* Mabille, 1891 is revised comprising three species including descriptions of two new species. Three new genera are presented: first, an African-Madagascan sister genus-group, namely *Shimbania* **gen. nov.** and *Morondavania* **gen. nov.** The genus *Morondavania* is monotypic and comprises one new species, while *Shimbania* comprises 13 species, of which 11 species are new to science. *Lebedodes wichgrafi* (Grünberg, 1910) and *L. durbanica* Hampson, 1910 are treated as valid species and are moved to the new genus *Shimbania*. Secondly, the monotypic *Eberhardfischeria* **gen. nov.** that shares one synapomorphy with *Saalmulleria*. The species *S. dubiefi* (Viette, 1974) is excluded from *Saalmulleria*, since it most probably represents another undescribed genus. Species of *Shimbania* occur along the eastern coast of the African mainland up to about 540 km inland from the Indian Ocean, with one record from the Atlantic Ocean coast in Nigeria (Central Africa). The other three genera are endemic to Madagascar.

Key Words

Africa, *Eberhardfischeria*, Madagascar, *Morondavania*, *Saalmulleria*, *Shimbania*

Introduction

Worldwide, 263 species of Metarbelidae are assigned to 36 known genera (Lehmann 2019a, b; Yakovlev and Zolotuhin 2020, 2021a, b, c, 2022; Yakovlev et al. 2022). Although no fewer than 218 species in 24 genera are recorded from the Afrotropics (De Prins and De Prins 2021), the group has only recently received systematic attention in this region. Lehmann (abbreviated as I.L. herein; 1997, 2007, 2008, 2009, 2010a, b, 2011, 2012, 2013, 2014, 2019a, b), Lehmann and Rajaei (2013), Lehmann et al. (2018), Lehmann et al. (2022b in review) and Lehmann et al. (2022a in review) discussed the diversity of the family in the Afrotropical (*sensu* Crosskey and White 1977), and Oriental Regions (*sensu* Wallace 1876), and revised 15 genera with descriptions and re-descriptions of 162 species, 139 of which are new to science from mainland Africa plus two from the Oriental Region. Additionally, Mey (2018) described one new genus and species from the Republic of South Africa and Yakovlev and Zolotuhin (2020, 2021a, b, c, 2022; Yakovlev et al. 2022) revised three genera, described six new genera and 14 new species from the Oriental Region. Lehmann (2019b) defined 60 genera from both regions in his Doctoral Dissertation based exclusively on morphological traits (Lehmann 2019b). Here, another three new genera are presented that were dealt with by Lehmann (2019b). Additionally, one new genus is added to the 60 genera mentioned above.

Taxonomy of Metarbelidae

The taxonomy, systematics and distribution of Metarbelidae within the Cossoidea were dealt with by Lehmann

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(2019b). Recent genetic studies confirmed the monophyletic status for the family Metarbelidae (Mayer et al. 2021).

Material and methods

The material examined is housed in the following collections (for abbreviations *cf.* De Prins and De Prins 2021):

BMNH	the Natural History Museum, London, U.K.
MNHN	the Natural History Museum, Paris, France
MWM in ZSM	the Museum Witt, Munich, Germany
NHMO	the Natural History Museum, University of Oslo, Norway
NMK	the National Museums of Kenya, Nairobi, Kenya
NRM	the Swedish Natural History Museum, Stockholm, Sweden
RMCA	the Royal Museum for Central Africa, Tervuren, Belgium
SNMF	Senckenberg Natural History Museum, Frankfurt / Main, Germany
TMSA	the Ditsong National Museum of Natural History (formerly Transvaal Museum), Pretoria, Republic of South Africa
ZMHU	the Natural History Museum and Leibniz Institute for Evolution and Biodiversity Research, Berlin, Germany (formerly ZMHB)
ZMUC	the Zoological Museum, University of Copenhagen, Denmark.

Specimens were photographed at different institutions using available equipment and compared with all described and imaged Metarbelidae species (Lehmann 2019a, b; Lehmann, unpubl. data 2022). Various specimens presented here were studied with a Scanning Electron Microscope and genitalia were prepared as described by Lehmann (2019b).

The terminology for external characters is based on Janse (1925), Scoble (1995), Edwards et al. (1999); for colours on Ridgway (1912); terminology for internal features is based on Sibatani et al. (1954) and Klots (1970). The terminology of the woody Leguminosae plant family is based on White et al. 2001. The biogeographic terminology follows White (1983), Goodman and Benstead (2003), Burgess et al. (2004) and Mucina and Rutherford (2006). The reclassification of White's (1983) "Zanzibar-Inhambane regional mosaic" into two regions, namely the "Swahilian/Maputaland regional transition zone" and "Swahilian regional centre of endemism" *sensu* Clarke (1998), is not dealt with here in regard to Metarbelidae to avoid too many terms for little known species.

The definition of any genus of Metarbelidae is based on autapomorphies and the definition of any sister-group is based on synapomorphies and follows the same method as presented by Lehmann (2019b).

Results

The 18 Afrotropical species treated herein belong to four genera: *Shimbania* gen. nov., *Morondavania* gen. nov., *Eberhardfischeria* gen. nov. and *Saalmulleria* Mabille, 1891. Species of *Shimbania* are restricted to coastal Nigeria (Central Africa) and to areas along the East Coast of Africa, from the Tana River (Kenya) southwards to Port St. Johns (Transkei Coastal Belt, Republic of South Africa), occurring inwards to *ca.* 540 km. They are restricted mainly to low and medium elevations, defined as areas below 1.300 m, as well as to few high elevations in the Central Bushveld (South Africa) and Eastern Arc Mountains (highest record at present from 1.900 m). In tropical Africa, areas below 600 m are defined as "lowland", between 600 m and 1.300 m are referred to as "submontane", and those above 1.300 m are considered "montane" (Keay 1959). The species of the three genera from Madagascar are endemic to this island and occur at present on low elevations below 800 m (*Saalmulleria*, *Eberhardfischeria* gen. nov., *Morondavania* gen. nov.) and medium elevations 800–1.800 m (*Saalmulleria*); elevations were defined by Du Puy and Moat (2003). *Morondavania* is the sister-group of *Shimbania*, representing the first link among Metarbelidae between the African mainland and Madagascar (*cf.* Gen. Nov. H and Gen. Nov. I in Lehmann 2019b, 2020).

Shimbania gen. nov.

https://zoobank.org/77DFB25C-196F-4927-8015-42577A843227

Type species of genus. *Shimbania baginerichardi* sp. nov. is designated as the type species.

Diagnosis. = Autapomorphies in Lehmann 2019b – The genus is defined by the following combination of characters (*cf.* Lehmann 2019b, 106–110): the thorn-like lower gnathal arm is 30–35% the size of valva, and is connected to the base of uncus by a long and narrow weakly sclerotized band that has 25–30% the width of the dorsal length of the thorn-like structure.

Differential diagnosis. (= Synapomorphies in Lehmann 2019b) shared with *Morondavania* gen. nov. from Madagascar.

***Forewing venation*:** R_1+R_2 originating from a long, well visible stalk (the stalk has the length of 25–60% of R_3) in both sexes.

***Male genitalia*:** Uncus narrow (60% or less than width of transtilla in ventral view), elongated with heavy appearance, strongly sclerotized, and with a more or less flat dorsal surface that is bent like a "C" in lateral view with a broadly rounded tip.

Lower part of gnathal arm represents a strongly sclerotized thorn with a broader base and an acuminate tip (15–35% the size of valva) and is connected in its upper part by a band to the base of uncus (the band has 30–50% the width of the thorn-like structure); the gnathal arms are connected by a narrow sclerotized band ventrally and end well above the costa of valva.

The transtilla (rarely present in Metarbelidae) is weakly sclerotized, very broad, *ca.* 30–40% of basal width of valva.

Diagnostic character in females of *Shimbania* gen. nov.

- A very large sclerotized base of the medium long posterior apophysis that is as large as *ca.* 40–50% of the papillae anales.

Diagnostic character in males of *Shimbania* gen. nov.

- The phallus is among the largest in Metarbelidae, with 30–40% as broad as basal width of valva on *ca.* 2/3 of its length and 20–30% longer than dorsal edge of valva; the remaining 1/3 is very narrow and bent upwards distally.

Description. ***Head*** (Figs 1a–d, 2a–e, 3a–f): Rough-scaled; long hair-like scales of olive-brown or greyish-olive or deep olive-buff on fronto-clypeus; a pair of pits absent in female (*cf. S. kerstinhempae* sp. nov.), but usually present or rudimentary in male (*cf. S. tanaensis* sp. nov., *S. mbarikaensis* sp. nov., *S. krooni* sp. nov.) on lower fronto-clypeus, a pair of small conical projections usually absent in males, but projections well visible in *S. krooni* sp. nov., rudimentary projections present in *S. mbarikaensis* sp. nov., sometimes present in females on lower fronto-clypeus at same position as in males; if present in females the projections are well developed, separated, but close together, small thorn-like in between two tiny slits or small oval holes behind labial palpi, holes or slits are sometimes absent in both sexes; labial palpi short or medium long, less than half of eye diameter, rarely longer (*cf. S. puguensis* sp. nov.), consisting of two segments; 2nd segment longest, elongated oval, up to 2.5–3.0× longer than 1st (basal) segment; apical palpomere usually absent, sometimes present, shortest, 0.3× length of basal segment in both sexes. Antennae in both sexes bipectinate, branches up 4.0× longer than width of shaft in males, also long in females with branches up 2.5–3.5× longer than width of shaft, branches are widely separated at base in both sexes with 1.5× width of branch, rarely not widely separated in males, dorsal and lateral sides of branches not scaled, but with many setae ventrally and laterally, dorsal and lateral sides of flagellum scaled in both sexes brown, ivory-yellow or greyish-olive.

***Thorax*:** Densely covered with hair-like scales of deep olive-buff or cream-olive on patagia, often these scales have a light grey or white tip, scales on patagia form often a collar ring, scales on tegulae dark chestnut or sepia with a vinaceous or light lilac glint in males, a glint is usually absent in females; long scale crest on metathorax, usually cream and dark chestnut at centre. Fore and mid legs cream-olive with long dense hair-like structures. Epiphyses present in both sexes, long, up to 2.0 mm in males, up to 2.5 mm in females, broad and flat, sometimes tube-like in females. Hindlegs usually deep olive-buff, on lower part of tarsus dark chestnut or light brown dorsally in males, but often only deep olive-buff in females, with two pairs of tibial spurs in both sexes (only *S. nigeriaensis* sp. nov. has one pair of tibial spurs), lower pair broader and shorter, up to 1.9 mm long, upper pair more narrow, up to 2.1 mm long, all spurs with thorn-like tip in both sexes. Wingspan is between 41.0 mm up to 54.0 mm with generally smaller species to the South of the Limpopo River (roughly to the South of Zimbabwe) with highest wingspan 48.0 mm, very often 44.0 mm or less. Forewing broad in both sexes, upperside usually with a light golden glint on an olive-grey or olive-cream ground-colour, sometimes inner half of forewing olive-brown, scale pattern is weak, usually a broad "Y"-shaped or "V"-shaped design occurs from near apex and costa or from R_5 to the middle or near end of CuA_1 or CuA_2, the latter is sometimes narrowly sepia in both sexes, usually several narrow olive lines are present from costa to dorsum, often interrupted by sepia veins in both sexes, termen without lunules, a dark chestnut or sepia patch is present below base of 1A+2A, sometimes faded. Hindwing is ivory-yellow or light olive-cream with a glint, sometimes with a light brown patch at end of discal cell, usually with light brown veins and several weak light brown or deep olive-buff patches at inner margin that sometimes form a weak reticulated pattern. Forewing venation similar in both sexes (Fig. 6a, b) with 1A+2A forked or only slightly forked at base; CuP absent; CuA_2 originating from near hind margin of posterior cell in both sexes; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell in both sexes; M_1 originating from distal margin of median cell in both sexes; areole always absent in both sexes; R_1+R_2 originating from a long stalk (the stalk has the length of 40–60% of R_3) and initiating from anterior margin of median cell in both sexes; R_3+R_4+R_5 are long stalked and originating from anterior angle of median cell; Sc more or less parallel to R_1. Hindwing venation similar in both sexes with 3A present, 1A+2A present usually as a sclerotized fold, rarely with a small fork at base, CuP usually absent and represented by a not sclerotized fold, if the fold is present, it is weak; CuA_2 originating from hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated; M_1 and Rs originating from apical angle of anterior cell, broadly separated in both sexes; without a bar from Rs to Sc+R_1 in both sexes, except *S. kerstinhempae* sp. nov. where a short bar is present near the base of both veins (Fig. 6a), with a small vein in discocellular cell on both fore- and hindwing, very rarely forked in forewing like in *S. baginerichardi* sp. nov. Fringe scales dark cream or olive, short in both sexes, up to 1.2 mm on forewing and hindwing. Retinaculum and frenulum are absent in both sexes.

***Abdomen*:** With dense hair-like scales of greyish-olive or olive-brown and abdominal tuft, usually short, not

longer than one-third of abdomen. Male genitalia (Figs 7e, 8a–d, 9a–d, 10A–C, 12a), with tegumen and vinculum fused, forming a firm narrow ring, with tegumen *ca.* 3.0–3.5× broader than vinculum, the latter forms a narrow (*cf. S. tanaensis* sp. nov., *S. krooni* sp. nov.) or broad ring ventrally (*cf. S. budaensis* sp. nov., *S. wanjakinuthiaae* sp. nov.). Uncus with heavy appearance, narrow elongated, well sclerotized, up to 40–90% of length of whole gnathos, flat dorsally, sometimes with a narrow graben-like surface ventrally, never bifurcated at tip, with few tiny setae ventrally and occasionally dorsally, tip rounded. Basal edge of uncus well developed, not bent at center. Gnathos has gnathos arms that are large, one arm 40–60% the size of valva: upper part of the gnathos arm is a long or short, weakly sclerotized band, as long as 25–50% of basal width of valva, that is attached to the basal part of uncus, the lower part of the gnathal arm is strongly sclerotized, of triangular or slightly rectangular shape (*cf. S. budaensis* sp. nov.) with a pronounced thorn-like structure and with its base in length up to 70% of the basal width of valva, sometimes smaller thorns are present along the dorsal edge or the dorsal edge is serrate or nearly straight (*cf. S. pwaniensis* sp. nov.), however, folds are always absent; the longest thorn might be hollow while the remaining part of the triangular-shaped or slightly rectangular-shaped gnathos is not hollow; the gnathal arms are connected ventrally by a sclerotized band that is as broad as 15–50% of the transtilla. The Gnathos is short and ends always well above the costa of valva. The valva is large, short and broad, or elongated and broad, almost rectangular, sometimes triangular, tip broadly or narrowly rounded (*cf. S. baginerichardi* sp. nov., *S. krooni* sp. nov.) or broadly pointed (*cf. S. puguensis* sp. nov.); sacculus narrow (*cf. S. kaguruensis* sp. nov.) or broad (*cf. S. budaensis* sp. nov.), weakly sclerotized, 30–60% of length of ventral edge of valva, costal margin only weakly sclerotized at base of valva; soft setae occur on inner side of valva, but no other structures are present. Saccus always absent. The vinculum is very narrow (*cf. S. krooni* sp. nov.) or very broad (*cf. S. budaensis* sp. nov.), juxta well developed, with two broadly oval or ear-shaped or broadly rectangular lobes and usually a deep V-shaped emargination in between lobes, the tips of lobes are broadly rounded (*cf. kaguruensis* sp. nov.) or pointed (*cf. durbanica*) or the dorsal edge of juxta is straight (*cf. S. krooni* sp. nov.). Phallus simple, tube-like, but very large, as broad as 35–50% of basal width of valva and up to 20–50% longer than costal width of valva, straight, usually strongly bent upwards at tip distally, vesica without cornuti. Female postabdominal structure and genitalia (Figs 7c, 10C) with papillae anales medium broad to narrow; dorsal part obliquely 8-shaped or elliptic in posterior view, covered with short and long setae. Segment 8 represents a medium broad rectangular sclerotized band, usually setose along its posterior margin with long setae, sometimes there is an oblique single row of medium long setae on the whole segment 8 (*cf. S. kerstinhempae* sp. nov.), with a very narrow band attached ventrally extending to the base of anterior apophysis; anterior apophysis up to 2.0× as long as segment 8 dorsally; posterior apophysis up to 50% the length of anterior apophysis and with a large sclerotized base up to 50% the size of the papillae anales in lateral view (in all females); ductus bursae thinly membranous, not sclerotized at base or thinly sclerotized at base (*cf. S. nigeriaensis* sp. nov.), narrow, very long, namely longer than the length of the very large corpus bursae or 3.0× as long as the dorsal width of segment 8, and among the longest in Metarbelidae (*cf. S. durbanica*); corpus bursae thinly membranous and without any structures or processes, elongated oval-shaped or broadly pear-shaped, very large, up to 2× as large as the broad segment 8 in lateral view.

Species richness. Currently, 13 species are included in this new genus of which 11 species are described as new to science.

Distribution. Species of *Shimbania* occur in southern and eastern Africa with a remarkable proximity to the Indian Ocean coast, with one (relict?) record from an area close to the Atlantic Ocean in coastal Nigeria (Lower Guinea, Central Africa) (*cf.* distribution map in Lehmann 2019b, fig. 51). The presented species are most probably restricted to various drier as well as wetter types of coastal lowland forest and/or woodlands, including riverine forests, as well as (rarely?) submontane and montane forests, *e.g.* on the Eastern Arc Mountains of Tanzania. Their distribution range extends within lowland areas of the "Tongaland-Pondoland regional mosaic" *sensu* White (1983) from the "Transkei Coastal Belt" (Republic of South Africa) northwards via the "KwaZulu-Natal Coastal Belt" and "Maputaland Coastal Belt" (within the Indian Ocean Coastal Belt) *sensu* Mucina et al. (2006b) inland to montane areas that belong to the "Zambezian regional centre of endemism" and are located close to the borderline with the "Kalahari-Highveld regional transition zone" *sensu* White (1983) and within the "Central Bushveld Bioregion" *sensu* Rutherford et al. (2006), *e.g.* Pretoria and Johannesburg located *ca.* 540 km inland from the Indian Ocean coastline. Along the latter coastline species extend northwards into the "Zanzibar-Inhambane regional mosaic" *sensu* White (1983), most probably through Mozambique, to eastern Tanzania and eastern Kenya. In eastern Tanzania, species of *Shimbania* occur *ca.* 300 km inland, *e.g.* in the Mahenge – Mbarika mountain chain (also known as Mbaraka Mountains *cf.* Kielland 1990), that is part of the "southern Eastern Arc Mountains" (*cf.* Lovett 1998) and of the "Afromontane archipelago-like regional centre of endemism" *sensu* White (1983). Via the transition zones of the Eastern Arc Mountains they extend probably into the Zambezian regional centre of endemism as well as Zanzibar-Inhambane regional mosaic. Further to the north, species occur on medium elevations at Usa River (1225 m, near Mount Meru) and within the transition zone of the Afromontane archipelago-like regional centre of endemism and the "Somalia-Masai regional centre of endemism" *sensu* White (1983). Within the Somalia-Masai regional centre of endemism species of *Shimbania* extend northwards into eastern Kenya, *e.g.* via Kibwezi (altitude 919 m, *ca.* 250 km inland from the Indian Ocean) to the Tana River. The Tana River Primate National Reserve (171 km^2, altitude

ca. 40 m, 80 km inland from the Indian Ocean) is located within the borderline of the Somalia-Masai regional centre of endemism and Zanzibar-Inhambane regional mosaic and is currently the most northeastern distribution limit and Port St. Johns in the Tongaland-Pondoland regional mosaic the most southeastern limit; an unknown coastal area in Nigeria is currently the most northwestern limit and is located in the "Guineo-Congolian regional centre of endemism" *sensu* White (1983); areas around Pretoria and within the Zambezian regional centre of endemism represent the southwestern limit. Within this vast area, species of *Shimbania* have a scattered, often isolated, small distribution that most probably is less than 50.000 km^2 per species (*cf. S. baginerichardi* sp. nov. and *S. tanaensis* sp. nov.).

Species of *Shimbania* occur from an altitude of 1 m (in coastal Nigeria) and 19 m (Shimo la Tewa, Kenya) up to 1.900 m (Ukaguru Mountains, Tanzania) in a range of climate types, *e.g.* warm temperate climate, subtropical humid climate and tropical wet and dry climate. The average annual rainfall in these habitats varies from at least 559 mm in the Central Bushveld Bioregion (Rutherford et al. 2006), between 300–1000 mm along the Lower and Upper Tana River (Andrews et al. 1975; Hughes 1990), 1073 mm at Mombasa / Shimo la Tewa, 1236 mm at Kisarawe Forest / Pugu Hills (Tanzania; Howell 1981), 1151–1263 mm in the Shimba Hills (Schultka 1974; Jätzold and Schmidt 1983) and 1300–1500 mm in the Mahenge-Mbarika mountain chain (CELP 2007) with the highest average rainfall in coastal Nigeria with 2000–3000 mm, locally more than 3000 mm.

The single record of a species of *Shimbania* from an unknown locality in coastal Nigeria is unusual, but if the two labels on this female are correct, species of *Shimbania* are also likely to occur in relict forests or woodlands in lowland, submontane and/or montane areas of Central Africa and West Africa.

Biological traits. The biology of all species of *Shimbania* is unknown at present**.** However, lowland tropical Metarbelidae species, as various species of *Shimbania*, are strongly associated to woody legumes, particularly with legume-dominated forests, woodlands or other legume-dominated woody vegetation types (Lehmann 2008, 2019b, Pp. 342–349) with few exceptions (Jenoh et al. 2016, 2021).

Etymology. The genus is named after Kenya's premier area for plant diversity (*cf.* Luke 2005), namely for the lowland area of the "Shimba Hills" (for more information on the etymology of the word "Shimba" see Appendix 1) in the southwest of Mombasa. The areas of the Shimba Hills and Mombasa represent two type localities for two new species of this genus.

The gender of the new genus is feminine.

Key to the species of *Shimbania*

The key is based primarily on characters of the genitalia; hence, it cannot serve as a field identification key. For the majority of species, only a few specimens are available, so identifications obtained from this key should be cross-checked carefully with the description, distribution, and figures presented in this paper. The males of *Shimbania kerstinhempae* sp. nov. and *S. nigeriaensis* sp. nov. are unknown.

1 Male 2
– Female 8
2(1) Valvae short, dorsal edge 1.3× or 1.4× length of uncus; valvae rectangular, distally broadly rounded 3
– Valvae long, dorsal edge at least 2.0× length of uncus 5
3(2) Viculum narrow 4
– Vinculum broad, ventrally at least 2.0× width of upper half of vinculum, broadest vinculum ventrally in genus, namely 55% as broad as basal width of valva ..... *S. wanjakinuthiaae* sp. nov.
4(3) Vinculum narrow, ventrally 1.2× width of upper half of vinculum, valvae with ventral edge not suddenly bent inwards ..... *S. baginerichardi* sp. nov.
– Vinculum narrow, uncus in fresh preparation with well visible thickening ventrally ..... *S. wichgrafi*
5(2) Valvae triangular, distally pointed 6
– Valvae rectangular, distally broadly rectangular 7
6(5) Antennae short, only 0.30 length of forewing ..... *S. kaguruensis* sp. nov.
– Not as above, uncus very long with 90% of vertical length of gnathos ..... *S. puguensis* sp. nov.
– Not as above, valva with very long dorsal edge of 2.4× length of uncus, short uncus with 60% of vertical length of gnathos ..... *S. krooni* sp. nov.
7(5) Large gnathal arms, one arm at least 50% the size of valva, valvae suddenly bent inwards ventrally ..... *S. tanaensis* sp. nov.
– Not as above, vinculum with wavy shape on entire length ..... *S. pwaniensis* sp. nov.
– Not as above, broadest tegumen in genus, namely broader than length of upper band-like structure on gnathos ..... *S. durbanica*
– Not as above, vinculum very broad ventrally, 2.2× width of upper half of vinculum and 45% as broad as basal width of valva ..... *S. budaensis* sp. nov.
– Not as above, tegumen narrow with only 30% of basal width of valva, band that connects gnathal arms ventrally only 20% width of transtilla, widely bifurcated in the middle, ventral edge of valva oblique ..... *S. mbarikaensis* sp. nov.

8(1) One pair of tibial spurs present on hindleg, dorsal gap on segment 8 present ..... *S. nigeriaensis* sp. nov.
– Two pairs of tibial spurs present on hindleg, dorsal gap absent 9
9(8) Anterior apophyses almost equal in length to dorsal length of segment 8; base of posterior apophyses large, 40% size of papillae anales.....*S. kerstinhempae* sp. nov.
– Anterior apophyses at least 2.0× longer than dorsal length of segment 8; base of posterior apophyses very large, 50% size of papillae anales, ductus bursae very long with 3×length of segment 8 dorsally .....*S. durbanica*

Shimbania baginerichardi sp. nov.

https://zoobank.org/74DDDA31-4F92-4C97-9AB1-045B5968E482

Figs 1a, 8a; fig. 53 in Lehmann (2019b)

Material examined. ***Holotype***, male, Kenya, [South] Coast, [Kwale County], Shimba Hills [National Reserve], April 1964, R.H. Carcasson leg., genitalia slide number 16/012009 I. Lehmann (NMK). ***Paratype***, male, same locality, December 1961, R.H. Carcasson leg., genitalia slide number 03/102005 I. Lehmann (NMK).

Selection of type species. *Shimbania baginerichardi* sp. nov. has been selected as type species of the new genus *Shimbania* because of the comprehensive area knowledge of I.L. that is based on several field trips undertaken by I.L., some with the botanist Quentin Luke (Nairobi), into the forests of the Shimba Hills in connection with the long-term field studies on forest structure, floristic diversity and plant species dominance as well as Lepidoptera diversity that were undertaken by I.L. in collaboration with the NMK over a period of 14 years (1994–2007) in five coastal forests that are located to the East and to the Southeast of the Shimba Hills in a distance of 9–15 km to the latter with a distance to the Indian Ocean of 100 m–5.5 km. These lowland forests are compared with the habitat of the holotype and paratype; comprising Kaya Muhaka, Kaya Kinondo, Kaya Diani (*cf.* Lehmann 1997, 1998; Lehmann and Kioko 2000, 2005; Lehmann 2020) as well as Gogoni Forest Reserve and Shimoni Forest (Lehmann unpubl. data collected in 2001–2007).

Description. Male. ***Head*:** with dense, short hair-like scales of dark chestnut between and around compound eyes; eyes olive-brown without spots; a pair of tiny rudimentary pits is present on lower fronto-clypeus; pits behind labial palpi are absent; antenna 0.30 length of forewing, bipectinate, with branches of 3.5× width of shaft, branches not scaled and shaft densely scaled, ivory-yellow dorsally; labial palpi chestnut.

***Thorax*:** Patagia olive-cream, forming a collar ring; tegulae with long hair-like dark chestnut scales with a vinaceous glint. Metathorax with small crest of olive-cream scales, crest dark chestnut at center. Hind legs olive-cream with fine hair-like scales, on lower part of tarsus dark chestnut dorsally; two pairs of long tibial spurs of unequal width and length, upper pair narrow *ca.* 1.5 mm and 1.4 mm, lower pair broader *ca.* 1.0 mm and 1.2 mm long. Forewing length 21.5 mm and wingspan 50.0 mm in holotype (wingspan 51.0 mm in paratype). Forewing upper-side light olive-cream with a light golden glint; below half of 1A+2A a large dark chestnut patch; forewing with many narrow olive lines from near costal margin to dorsum, interrupted by narrowly brown veins; a large olive subterminal patch of triangular shape from below costal margin to near half of CuA_1; termen without striae or lunules; CuA_2 brown; remaining veins distinctly coloured and more or less brown; cilia short, 1.2 mm, olive-cream. Underside of forewing cream-olive with a golden glint and some narrow olive lines. Hindwing upperside light olive-cream, glossy, with brown veins and some pale olive patches; cilia as in forewing; underside as in forewing.

***Abdomen*:** Mainly cream-olive mixed with ivory-yellow, glossy; abdominal tuft cream-olive, short, 1/5 length of abdomen. Genitalia with long uncus, 60% of length of whole gnathos, with a narrow graben-like surface ventrally. Gnathos has gnathos arms that are small, one arm 40% the size of valva; upper part of the gnathos arm is a short band as long as 40% of basal width of valva, the lower part of the gnathal arm is small, and it does not touch the other arm but is well separated from it (ventral view), of elongated triangular shape with a pronounced thorn-like structure and with its base 50% of the basal width of valva, without smaller thorns along its wavy dorsal edge; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 30% of the transtilla and is narrowly bifurcated at the middle. The Gnathos ends well above the dorsal edge of the transtilla. The valva is short with a dorsal edge of 1.3× the length of uncus, rectangular, tip broadly rounded; sacculus narrow, weakly sclerotized, 30% of length of ventral edge of valva; juxta well developed, with two broadly ear-shaped lobes and a broadly V-shaped emargination in between that is 30% the length of juxta, tips of lobes pointed. Phallus very large, as broad as 50% of basal width of valva and 50% longer than costal width of valva, only slightly S-shaped and bent upwards at tip distally, vesica without cornuti.

Female. Unknown.

Diagnosis. *Shimbania baginerichardi* sp. nov. can be separated from all other congeners by the short, rectangular and broadly rounded valva distally, as well as the small, narrow, lower part of one gnathal arm that is only slightly broader than the ventral base of the vinculum. Two character states are similar to *S. budaensis* sp. nov.: the gnathal arms are connected ventrally by a sclerotized band that is narrowly bifurcated in the middle, and the lower part of the gnathal arm does not touch the other arm but is well separated from it (ventral view). Differences from the latter species include the following: the valva is more elongated with a dorsal edge of 2.2× the length

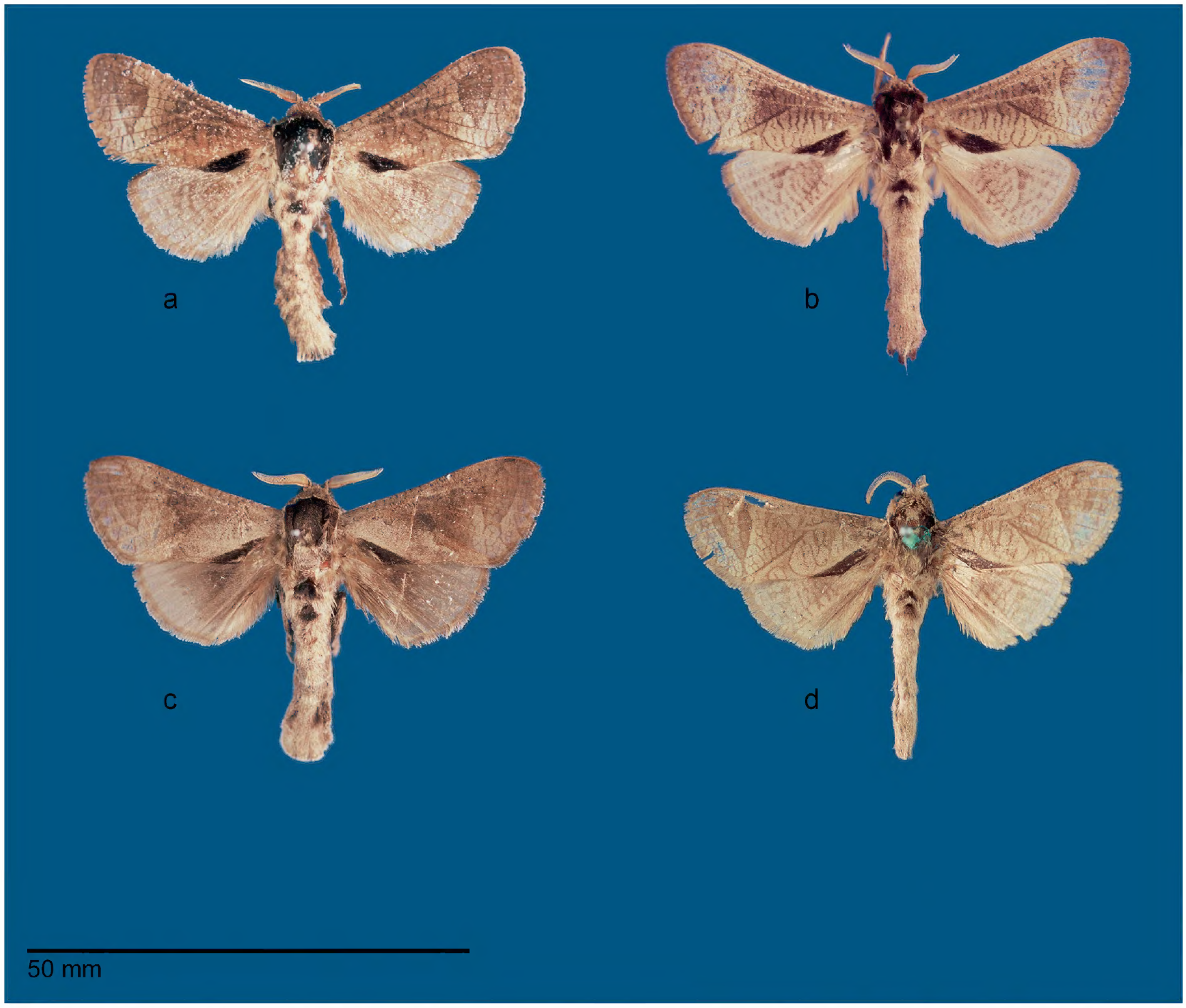


Figure 1. a. *Shimbania baginerichardi* sp. nov., holotype, male, Kenya, Kwale County, Shimba Hills National Reserve; **b.** *S. budaensis* sp. nov., holotype, male, Kenya, Kwale County, Buda Forest Reserve; **c.** *S. tanaensis* sp. nov., holotype, male, Kenya, Tana River County, Mchelelo Camp, close to the Tana River; **d.** *S. tanaensis* sp. nov., paratype, male, Kenya, Mombasa County, Shimo la Tewa.

of uncus, while in *S. baginerichardi* sp. nov. the dorsal edge is 1.3× the length of uncus; the ventral base of the vinculum is very broad and 2.1× the width of the upper part of vinculum, while in *S. baginerichardi* sp. nov. the ventral base of the vinculum is narrow and 1.2× the width of the upper part of vinculum; the tegumen is narrower than the lower part of one gnathal arm as the latter is 1.2× broader than the tegumen in *S. budaensis* sp. nov., while in *S. baginerichardi* sp. nov. the tegumen is 1.6× broader than the lower part of one gnathal arm.

Distribution. *Shimbania baginerichardi* sp. nov. is classified here as a lowland coastal forest species that is at present endemic to the "Usambara-Kwale local centre of endemism" *sensu* Burgess (2000) located within the Zanzibar-Inhambane regional mosaic. The species is only known from the Shimba Hills and was never recorded by I.L. during 14 years of extensive fieldwork in the five coastal forests mentioned above nor in light-trappings undertaken by I.L. in other habitats, *e.g.* in Malindi, Gede, Shimo la Tewa (Kenya, North Coast); Ukunda, Diani, Kinondo village, north of Gogoni Forest Reserve, near Gazi village and in the village Shimoni (Kenya, South Coast).

Habitat of type species. The coastal forests of Kenya belong to the global biodiversity hotspot "Coastal forests of Eastern Africa" comprising high diversities and endemism among plants and animals. This hotspot is among the top ten priority ecosystems for biodiversity conservation on the African continent (Burgess 2000). The Kenyan coastal forests are home to 2,489 vascular plant species or 39.55% of all plant species found in Kenya with 90 endemic species and with the Leguminosae (Fabaceae) as the most species-rich family comprising 226 species (Ngumbau et al. 2020). The Shimba Hills have a mosaic of grasslands (decreasing rapidly along the coast and in many areas of Kenya!), scrub, exotic plantations and coastal forest of which large parts are protected since 1903 with subsequent extensions and gazetted areas as National Reserve as well as Forest Reserve until 1968. The forests represent

the second largest coastal forest in Kenya (253 km²) and were found to be Kenya's premier area for plant diversity (Luke 2005) as well as the richest Kenyan coastal forest with the highest number of woody plant species comprising 498 species, and hence they have 207 woody species more than Kenya's largest coastal forest Arabuko-Sokoke (420 km²) (Fungomeli et al. 2020). A checklist for the Shimba Hills, including also non-forest habitats and adjacent forest patches (but excluding the five forests studied by Lehmann and Kioko 2005; Lehmann unpubl. data collected in 2001–2007), was compiled by Luke (2005) for an area of *ca.* 600 km². His checklist comprises 1,396 indigenous plant species in 686 genera and 143 families, representing 44% of the coastal flora. In regard to this enormous species diversity, Luke (2005) stated that one reason "is probably the Shimba's proximity" to the ancient East and West Usambara Mountains (Tanzania) where 2,855 plant species occur (Iversen 1991). Looking into such a diverse floristic background of the type locality it is remarkable that only one species of *Shimbania*, represented by two specimens of *S. baginerichardi* sp. nov., is known from the Shimba Hills with no further record from forest and non-forest areas adjacent to the East and Southeast of the Shimba Hills (*cf.* Lehmann and Kioko 2000, 2005; Lehmann unpubl. data collected in 2001–2007), nor from Amani in the East Usambara Mountains and nor from various places in the West Usambara Mountains (Lehmann in prep.).

Schmidt (1991) studied the forests of the Shimba Hills and defined four "forest plant communities" with a hierarchical arrangement of "plant formations" including six major "plant community groups" and seven major "plant communities". Among the latter are two communities that are of interest here because of their original character, their occurrence on a large area in the Shimba Hills and their characteristic components including woody legumes. First, the *"Lagynias pallidiflora* community*"* as part of the *"Olyra-Rawsonia* community group*"* is the "most original vegetation type on Magarini sands" that are of Pliocene age and extend in a broad band from northeast to southwest along the eastern part of the Shimba Hills and eastwards to near the western side adjacent to Kaya Muhaka and Gogoni Forest Reserve. The characteristic species of this most original vegetation type are *Lagynias pallidiflora* Bullock (Rubiaceae), *Olax obtusifolia* De Wild. (Olacaceae), *Albizia glaberrima* Benth. (Leguminosae-Mimosoideae), *Cola octoloboides* Brenan (Sterculiaceae) and large climbers like *Caesalpinia volkensii* Harms (Leguminosae-Caesalpinioideae). Second, the "*Paramacrolobium coeruleum* community" that is widely distributed within the "tropical evergreen seasonal lowland forest plant community" and occurs on Upper Triassic "Mazeras sandstone" and "Shimba grit" covering the largest area on the Shimba Hills. The upper tree stratum is dominated by *Paramacrolobium coeruleum* J. Léonhard (Leguminosae-Caesalpinioideae), *Julbernardia magnistipulata* Troupin (Leguminosae-Caesalpinioideae), *Albizia glaberrima* Benth. (Leguminosae-Mimosoideae) and *Synsepalum brevipes* T.D. Penn. (Sapotaceae). A similar dominance of *Julbernardia magnistipulata* Troupin (Leguminosae-Caesalpinioideae) and *Synsepalum brevipes* T.D. Penn. (Sapotaceae) was found in certain parts of Kaya Muhaka (Lehmann and Kioko 2000, 2005) as well as in Gogoni Forest Reserve (Lehmann unpubl. data collected in 2001–2007), but the dominance of woody legumes is entirely absent in coastal forests that occur along the shore line of the Indian Ocean, *e.g.* Kaya Diani, Kaya Kinondo (Lehmann and Kioko 2005; Lehmann 2019b) and in Shimoni Forest (Lehmann unpubl. data collected in 2001–2007). Nevertheless, a species of *Shimbania* was never recorded neither in Kaya Muhaka nor in Gogoni Forest Reserve. Hence, *S. baginerichardi* sp. nov. does most probably have a sedentary behavior (*cf.* Lehmann 2019b, Pp. 325–326) and most probably occurs only very locally in the "Usambara-Kwale local centre of endemism", or might be restricted to the Shimba Hills. In regard to the very diverse flora, *e.g.* the newly described tree *Vangueriopsis shimbaensis* A.P. Davis & Q. Luke 2010 (Rubiaceae) is also restricted to the Shimba Hills (Ngumbau et al. 2020); its flowers were first photographed by Lehmann & Luke in 2005 (*cf.* Davis and Luke 2010).

Etymology. *Shimbania baginerichardi* is named for Dr. Richard Kiome Bagine (Nairobi, Kenya) for his friendship until present, for his significant support and long-term guidance of the research of I.L. in Kenya during 1989–2008, *e.g.* on various research permits, particularly for Kaya Muhaka, Kaya Kinondo and Shimoni Forest, first as the Head of Division of Natural Sciences and then as Deputy Director and Chief Scientist of the Center for Biodiversity of the National Museums of Kenya (NMK) as well as Deputy Director and Chief Research Scientist for Biodiversity Research of the Kenya Wildlife Service (KWS). His research work focused, *e.g.* on the ecology and diversity of East African termites. The gender of the new species name is a noun.

Shimbania tanaensis sp. nov.

https://zoobank.org/27F12FA3-57ED-4BA9-9B31-3ADCFE3DCE7C

Figs 1c, d, 8b, 12a

Material examined. ***Holotype*** male, Kenya, [North Coast], [Tana River County], [just south of] Mchelelo Camp [KWS], Riverine Forest, 01°52'59"S, 40°08'20"E, 251 m [incorrect altitude that is 45 m], Mercury Vapor Light, 17–18 March 1999, [Dr.] K. Maes [leg.], genitalia slide number 07/012009 I. Lehmann (NMK). ***Paratypes*:** one male, same label data, genitalia slide number 03/022009 I. Lehmann (NMK); one male,

Kenya, [Makueni County], Kibwezi, 08–14 May 1995, Dr. Politzar leg., genitalia slide number 25/072009 I. Lehmann (MWM); one male, Kenya, [North Coast], [Mombasa County], Shimo la Tewa [also Shemu-li-Tewa], 06 April 1932, Stoneham [leg.?], genitalia slide number 13/012008 I. Lehmann (NMK).

Description. ***Head*:** olive-brown, short scales, glossy; eyes black; a pair of pits present on lower fronto-clypeus (also in paratypes); pits behind labial palpi small (also in paratypes); antenna 0.35 length of forewing, bipectinate, branches 3.6× width of shaft, not scaled, widely separated at base, 2× width of branch; shaft densely covered with cream scales dorsally; labial palpi dark chestnut.

***Thorax*:** Patagia is olive, forming a collar ring, scales with light grey tips; tegulae with long hair-like chestnut scales with a light vinaceous glint. Metathorax with small crest of cream scales, crest chestnut at center with a light vinaceous glint. Hind legs olive-cream with fine hair-like scales with light grey tips, on lower part of tarsus sepia dorsally; two pairs of long tibial spurs of unequal width and length, upper pair narrow *ca.* 1.6 mm and 1.4 mm, lower pair of spurs broader *ca.* 1.0 mm and 1.3 mm long. Forewing length is 23.0 mm and wingspan 51.0 mm in holotype (wingspan 47.0–54.0 mm in paratypes). Forewing upperside brown-olive on inner half and olive-grey on outer half with a light golden glint; below first half of 1A+2A a large dark chestnut patch; forewing without many narrow olive lines, all veins narrowly sepia; a weak subterminal patch, V-shaped, possibly only visible in fresh males, from below costal margin to near end of CuA_1; termen without striae or lunules; cilia short, 1.1 mm, olive with grey tips. Underside of forewing is light grey-olive with a golden glint. Hindwing upperside is light grey-olive, glossy, with weak light brown lines; cilia as in forewing; underside as in forewing but with weak brown lines.

***Abdomen*:** Mainly light olive mixed with cream, glossy; abdominal tuft light olive, medium long, 1/4 length of abdomen. Genitalia with long uncus, 70% of length of whole gnathos, with a narrow graben-like surface ventrally. Gnathos has gnathos arms that are large, one arm 50% the size of valva; upper part of gnathos arm is a long band (if compared to *S. baginerichardi* sp. nov.) as long as 65% of basal width of valva, the lower part of the gnathal arm is large, and it does touch or almost touch the other arm (ventral view), of broad triangular shape with a pronounced thorn-like structure and with its base 90% of the basal width of valva, with several smaller thorns along its dorsal edge; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 25% of the transtilla and is widely bifurcated in the middle. The Gnathos arms end well above the dorsal edge of transtilla. The valva is elongated with a dorsal edge of 2.0× the length of uncus, rectangular, ventral edge of valva strongly bent inwards at 60% of length with a tip that is broadly rounded; sacculus long, narrow, weakly sclerotized, 60% of length of ventral edge of valva; saccus absent; juxta well developed, with two broadly ear-shaped lobes with a broadly V-shaped emargination in between that is 60% the length of juxta, tips of lobes pointed. Phallus very large, as broad as 40% of basal width of valva and 30% longer than costal width of valva, only slightly S-shaped and bent upwards at tip distally, vesica without cornuti.

Female. Unknown.

Diagnosis. *Shimbania tanaensis* sp. nov. can be separated from all other congeners by the large gnathal arm that is at least 50% the size of valva with its upper part representing a long band that is as long as 65% of basal width of valva and with its lower part that does touch or almost touch the other arm (in lateral view both gnathal arms touch each other in holotype and all paratypes); the latter are well separated in *S. baginerichardi* sp. nov. where the band is only 40% of the basal width of valva and the gnathal arm is not larger than 40% of the valva. Furthermore, the gnathal arms are connected ventrally by a sclerotized band that is narrowly bifurcated in the middle in *S. baginerichardi* sp. nov., but widely bifurcated in *S. tanaensis* sp. nov. In addition to these characters, the valva is more elongated with a dorsal edge of 2.0× the length of uncus and the ventral edge that is suddenly strongly bent inwards at 60% of the ventral edge, while in *S. baginerichardi* sp. nov. the dorsal edge is 1.3× the length of uncus and the ventral edge is not suddenly strongly bent inwards, but oblique towards tip. One common character with *S. baginerichardi* sp. nov. is the narrow ventral base of the vinculum with 1.2× the width of the upper part of vinculum. Although the width is similar in both species the vinculum is straight cut at lower end in *S. tanaensis* sp. nov. but oval in *S. baginerichardi* sp. nov. A similar species in regard to the large size of the lower gnathal arm and elongated valvae but with a pointed tip is *S. pwaniensis* sp. nov. The most striking difference to *S. tanaensis* sp. nov. is the broad and wavy vinculum at its lower end (*cf.* diagnosis of *S. pwaniensis* sp. nov. below).

Distribution. *Shimbania tanaensis* sp. nov. is known from coastal areas north of Mombasa to the Tana River and westwards to Kibwezi, a locality where various coastal Metarbelidae occur. Hence, this species is present in the Somalia-Masai regional centre of endemism as well as in the Zanzibar-Inhambane regional mosaic. Based on its distribution, *S. tanaensis* sp. nov. can be classified as an endemic species to eastern Kenya.

Etymology. *Shimbania tanaensis* is named for the Tana River (Kenya) with its distinct riparian forest patches, including one forest patch that is the habitat of the holotype and one paratype, and to remember my (I.L.) Diploma Thesis in Kenya with my first collection of leaves from the rare Kenyan endemic riparian tree species *Populus ilicifolia* Rouleau (Salicaceae) along the Tana River, near Hola, in 1989.

The gender of the new species name is feminine.

Shimbania budaensis sp. nov.

https://zoobank.org/0302D564-5215-4507-8E2F-92215BCACE65

Figs 1b, 8c

Material examined. ***Holotype***, male, Kenya, South Coast, [Kwale County], Buda Forest [Reserve], 0 m [incorrect altitude that is 27–93 m], 15 January – 01st February 1995, mercury vapor light, Dr. Politzar leg., genitalia slide number 05/082009 I. Lehmann (MWM).

Description. ***Head*:** with dense, short hair-like scales of light brown and ivory-yellow between and around eyes; eyes olive with black spots; a pair of pits are present on lower fronto-clypeus; pits behind labial palpi are tiny slits; antenna 0.36 length of forewing, bipectinate, with branches of 4× width of shaft, branches not scaled and shaft densely scaled, cream dorsally; labial palpi brown.

***Thorax*:** Patagia grey-vinaceous, forming a collar ring; tegulae with long hair-like dark chestnut scales with a slightly vinaceous glint. Metathorax with small crest of ivory-yellow scales, crest brown at center. Hind legs olive-grey with fine hair-like scales, on lower part of tarsus olive (instead of brown) dorsally; two pairs of long tibial spurs of unequal width and length, upper pair narrow *ca.* 2.0 mm and 1.5 mm, lower pair of spurs broader *ca.* 1.5 mm and 1.0 mm long. Forewing length 23.5 mm and wingspan 52.0 mm. Forewing upperside light grey-olive with a light golden glint, but upper inner half is dark olive; below half of 1A+2A a large dark chestnut patch; forewing with many narrow brown-olive lines from near costal margin to dorsum, only few are interrupted by narrowly brown veins; a large, but weak olive sub-terminal patch is "V"-shaped from R_3 to near half of CuA_1; termen without striae or lunules; CuA_2 brown, with a brown streak extending into discal cell; remaining veins are not distinctly coloured with few exceptions; cilia short, 1.1 mm, with cream base and grey tips. Underside of forewing olive-buff with a golden glint and some dark olive-buff patches and short lines. Hindwing upperside ivory-yellow with a light golden glint, without brown veins and hence, all veins are not distinctly coloured, some pale olive-buff patches occur; cilia as in forewing; underside as in forewing.

***Abdomen*:** Mainly cream-olive mixed with ivory-yellow, glossy; abdominal tuft cream-olive and pale olive-buff, short, 1/5 length of abdomen. Genitalia with long uncus, 60% of length of whole gnathos, with a narrow graben-like surface ventrally. Gnathos has gnathos arms that are large, one arm 60% the size of valva; upper part of the gnathos arm is a long band, as long as 65% of basal width of valva, the lower part of the gnathal arm is large, and it does not touch the other arm but is well separated from it (ventral view), of broadly slightly rectangular (instead of triangular) shape with a pronounced thorn-like structure and with its base 70% of the basal width of valva, without smaller thorns along its slightly wavy dorsal edge; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 30% of the transtilla and is narrowly bifurcated at the middle. The Gnathos ends well above the dorsal edge of the transtilla. The valva is elongated rectangular with a dorsal edge of 2.2× the length of uncus, tip broadly rounded; ventral edge is bent suddenly inwards and has a well pronounced sacculus that is broad on its first half, as broad as 25% of width of valva, sclerotized, long, 90% of length of ventral edge of valva; saccus absent; juxta well developed, with two broadly ear-shaped lobes and a broadly V-shaped emargination in between, it is 60% the length of juxta, tips of lobes pointed. Phallus very large, as broad as 40% of basal width of valva and 25% longer than costal width of valva, only slightly S-shaped and bent upwards at tip distally, vesica without cornuti. The basal width of the vinculum is among the broadest in *Shimbania*.

Female. Unknown.

Diagnosis. *Shimbania budaensis* sp. nov. can be separated from all other congeners by the very broad ventral base of the vinculum that has 45% of the basal width of its elongated valva and hence, is at present among the two broadest ventral bases of a vinculum among *Shimbania*. Only *S. wanjakinuthiaae* sp. nov. has a broader ventral base of vinculum, but can easily be separated from the former species by its very broad and short rectangular valva with a costal margin that has only 1.4× the length of the uncus and with a ventral margin that is not suddenly bent inwards. Additionally, the sacculus is broadest, longest and well sclerotized in *S. budaensis* sp. nov. if compared to all other species presented herein.

Distribution. *Shimbania budaensis* sp. nov. is classified as a lowland coastal forest species that is at present endemic to the "Usambara-Kwale local centre of endemism" *sensu* Burgess (2000). The species is only known from Buda Forest Reserve (6.7 km² in size) located *ca.* 6 km inland from the Indian Ocean, *ca.* 3 km southwest from Gogoni Forest Reserve, where a species of *Shimbania* was never recorded (Lehmann unpubl. data collected in 2001–2007), and *ca.* 16 km southwest from Kaya Muhaka (Lehmann and Kioko 1998, 2005). Noteworthy, Buda Forest has among 30 studied Kenyan coastal forests very high species diversities and is in this aspect among the seven top sites (Fungomeli et al. 2020).

Etymology. *Shimbania budaensis* is named for the Buda Forest Reserve (Kenya) and to remember my (I.L.) first observations on larger moths in various coastal forests, such as Buda Forest, undertaken by bicycle in 1989.

The gender of the new species name is feminine.

Shimbania pwaniensis sp. nov.

https://zoobank.org/6DA3DAD5-6565-4E80-9998-29C25EE39856

Figs 2a, 8d

Material examined. ***Holotype*** male, Tanzania, Pwani Region, route [road] Dar [es-Salaam] — Chalinze, "près passage voie ferré" ["near the railway crossing" / crossing *ca.* 2 km from the Ruvu River?], "savane" [savannah with a patch of riverine forest nearby?], 40 m, 01 May 2005, Ph. Darge [leg.], genitalia slide number 28/022009 I. Lehmann (MWM).

Figure 2. a. *Shimbania pwaniensis* sp. nov., holotype, male, Tanzania, Pwani Region, road from Dar es-Salaam to Chalinze, near the railway crossing, ca. 2 km from Ruvu River; **b.** *S. puguensis* sp. nov., holotype, male, Tanzania, Pwani Region, Pugu Forest; **c.** *S. kaguruensis* sp. nov., holotype, male, Tanzania, Morogoro Region, Kaguru Mountains; **d.** *S. mbarikaensis* sp. nov., holotype, male, Tanzania, Morogoro Region, Mbarika Mountains, south of Mahenge Forest; **e.** *S. kerstinhempae* sp. nov., holotype, female, Tanzania, Arusha Region, Usa River, Danish Volunteer Training Centre.

Description. ***Head*:** dark chestnut, short scales, glossy; eyes dark vinaceous and surrounded by long hair-like scales of dark chestnut; a pair of pits are present on lower fronto-clypeus; pits behind labial palpi absent; antenna 0.29 length of forewing, bipectinate, branches 3.5× width of shaft, not scaled, not widely separated at base; shaft densely covered with cream scales dorsally; labial palpi mummy brown.

***Thorax*:** Patagia deep olive, forming a collar ring, scales with light grey tips; tegulae with long hair-like dark chestnut and black scales with a light vinaceous glint. Metathorax with crest of olive scales. Hind legs dark olive-cream with fine hair-like scales with light grey tips, on lower part of tarsus dark chestnut and black dorsally; two pairs of long tibial spurs of unequal width and length, upper pair narrow *ca.* 1.0 mm and 1.3 mm, lower pair of spurs broader *ca.* 1.2 mm and 1.4 mm long. Forewing length is 24.0 mm and wingspan 53.5 mm. Forewing upperside brownish-olive on inner half and cream-buff on outer half with a light golden glint, particularly below lower median to dorsum; below first 2/3 of 1A+2A a large dark chestnut patch mixed with black; forewing with many narrow brownish-olive lines from costa to dorsum, all veins also narrowly brownish-olive; a large and well visible brownish-olive subterminal patch, almost oval-shaped, from R_2 to near middle and to near end of CuA_1; termen with only few weak brownish-olive lunules; cilia short, 1.2 mm, olive with grey tips. Underside of forewing cream-buff with weak brownish-olive lines and patches with a golden glint. Hindwing upperside cream-buff with a light golden glint and with weak brownish-olive lines; cilia as in forewing; underside as in forewing.

***Abdomen*:** Mainly olive mixed with cream-buff, glossy; abdominal tuft light olive and cream-buff, medium long, 1/4 length of abdomen. Genitalia with long uncus, 70% of length of whole gnathos, narrow, graben-like surface ventrally absent. Gnathos has gnathos arms that are large, one arm 40% the size of valva; upper part of the gnathos arm is a short band as long as 40% of basal width of valva, the lower part of the gnathal arm is large, and it does not touch the other arm but is well separated (ventral view), of broad triangular shape with a pronounced thorn-like structure and with its base 50% of the basal width of valva, without any smaller thorns as well as without a serrate dorsal edge; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 30% of the transtilla and is widely bifurcated in the middle. The Gnathos arms end well above the dorsal edge of the transtilla. The valva is elongated with a dorsal edge of 2.0× the length of uncus, rectangular, ventral edge of valva S-shaped with a tip that is slightly pointed (instead of broadly rounded); sacculus not pronounced, narrow, sclerotized, 40% of length of ventral edge of valva; juxta well developed, with two broadly oval-shaped lobes and a narrowly V-shaped emargination in between, 50% the length of juxta, tips of lobes rounded. Phallus broken at middle.

Female. Unknown.

Diagnosis. *Shimbania pwaniensis* sp. nov. can be separated from all other congeners by the wavy shape of the vinculum, including the ventral part, and the large gnathal arms of triangular shape with only one thorn-like appendice in front of an entirely straight dorsal edge. Furthermore, the valva has an S-shaped ventral margin with a pointed tip distally (*cf.* diagnosis of *S. tanaensis* sp. nov. above).

Distribution. *Shimbania pwaniensis* sp. nov. is known from the "Usaramo floristic area" *sensu* Hawthorne (1984) that represents a "Southern element" within the coastal forests of East Africa and belongs to the Zanzibar-Inhambane regional mosaic. The new species was probably collected near the railway crossing (6°40'55"S, 38°40'20"E at an altitude of 37 m) and close to the Ruvu River with riverine forest patches nearby, *ca.* 66 km west of Dar es-Salaam. Based on its distribution, *S. pwaniensis* sp. nov. can be classified as a lowland species that is endemic to the coastal forests, probably also to the riverine forests, in the Usaramo floristic area; it might be widely distributed in such habitats in the Pwani Region.

Etymology. *Shimbania pwaniensis* is named after the administrative Pwani Region (Tanzania) with its distinct but little known coastal forests as well as riverine forest patches, *e.g.* north of the Mbala-Kwalaza road, Pugu Forest Reserve, Kisiju Forest and Mkuranga Forest, located to the West, Southwest and South of Dar es-Salaam. The word "pwani" is KiSwahili and means "coast".

The gender of the new species name is feminine.

Shimbania puguensis sp. nov.

https://zoobank.org/244C6A80-198E-439B-A6B1-8A9F47C6C556

Figs 2b, 9a

Material examined. ***Holotype*** male, Tanzania, Pwani Region, Pugu Forest [Pugu Hills Nature Forest?], 132 m [*ca.* 132–248 m], 29 November 2004, ex coll. Ph. Darge, local collector [not named], genitalia slide number 18/012009 I. Lehmann (ZSM). Paratype male, Tanzania, Dar es-Salaam Region [incorrect Pwani Region], Kisarawe Forest, 06°53.877'S, 039°05.189'E [06°53'S, 39°05'E], 267 m [incorrect, altitude is 182 m], 06 June 2004, Ph. Darge [leg.], genitalia slide number 01/012009 I. Lehmann (MWM).

Description. ***Head*:** only ventrally dark chestnut, the rest is deep olive-buff (*cf. pwaniensis* sp. nov. that has only dark chestnut scales on the head), short scales with cream tips, glossy; eyes light brown-olive with black spots and surrounded by long hair-like scales of dark chestnut ventrally with a light lilac-vinaceous glint; a pair of pits is present on lower fronto-clypeus; pits behind labial palpi are tiny slits; antenna 0.40 length of forewing (0.35 in paratype; *cf.* shorter antennae in *pwaniensis* sp. nov.), bipectinate, branches 3.0× width of shaft (2.5× in paratype), not scaled, not widely separated at base; shaft densely covered with ivory-yellow scales dorsally; labial palpi dark brown and long (longer than half of eye diameter).

***Thorax*:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips; tegulae with long hair-like dark chestnut scales with a light lilac-vinaceous glint. Metathorax with crest of deep olive-buff scales, with a glint. Hind legs deep olive-buff with fine hair-like scales with light grey tips, on lower part of tarsus dark chestnut dorsally; two pairs of long tibial spurs of unequal width and length, upper pair narrow *ca.* 1.5 mm and 2.0 mm, lower pair of spurs slightly broader *ca.* 1.0 mm and 1.3 mm long. Forewing length 22.5 mm and wingspan

49.0 mm in holotype; 23.0 mm and wingspan 50.0 mm in paratype. Forewing upperside dark olive-buff on inner half and along costa, olive-buff on outer half and below CuA_2 with a light golden glint; below first half of 1A+2A a large dark chestnut patch with a light lilac-vinaceous glint; forewing with many narrow dark olive lines from costa to dorsum, many veins also narrowly dark olive including CuA_2 that extends as a dark olive streak into the discal cell; a large and well visible dark olive subterminal patch, broadly Y-shaped, from R_4 to near end of CuA_1; termen without lunules; cilia short, 1.2 mm, deep olive-buff with grey tips. Underside of forewing cream-buff with weak brownish-olive lines and a golden glint. Hindwing upperside olive-buff with a light golden glint and with deep olive-buff lines; cilia as in forewing; underside as in forewing.

***Abdomen*:** Mainly deep olive-buff mixed with ivory-yellow hair-like scales with a glint; abdominal tuft with hair-like scales of olive-buff and ivory-yellow, medium long, 1/4 length of abdomen. Genitalia with long uncus, 90% of length of whole gnathos (in holotype as well as paratype), narrow graben-like surface ventrally is present, well visible. Gnathos has gnathos arms that are small, one arm 20%–25% the size of valva (in holotype and paratype); upper part of the gnathos arm is a short band as long as 35% of basal width of valva, the lower part of the gnathal arm is small, and it does touch the other arm of broad triangular shape with a pronounced thorn-like structure and with its base 60% of the basal width of valva, with smaller thorns as well as a strongly serrate dorsal edge (in holotype and paratype); the gnathal arms are connected ventrally by a very narrow sclerotized band that is as broad as 20% of the transtilla and is not bifurcated in the middle. The Gnathos arms end well above the dorsal edge of the transtilla. The valva is triangular with a dorsal edge of 2.0× the length of uncus, ventral edge of valva slightly S-shaped with a tip that is pointed (instead of broadly rounded); sacculus pronounced, broad, sclerotized, 90% of length of ventral edge of valva; saccus absent; juxta well developed, with two broadly rounded lobes and a narrowly V-shaped emargination in between that is 20% the length of juxta, tips of lobes broadly rounded. Phallus very large, as broad as 35% of basal width of valva and 20% longer than costal width of valva, only slightly S-shaped and bent upwards at tip distally, vesica without cornuti.

Female. Unknown.

Diagnosis. *Shimbania puguensis* sp. nov. can be separated from all other congeners by the long narrow uncus that has 90% of length of whole gnathos, the triangular valva with a pointed tip, the small gnathal arms of triangular shape with one thorn-like appendice in front of several smaller thorns and a strongly serrate dorsal edge. The latter character is similar in *S. baginerichardi* sp. nov. as well as in *S. mbarikaensis* sp. nov., but both species have rectangular valvae with a broad and rounded end. The very narrow sclerotized band that connects the gnathal arms ventrally is only as broad as 20% of the transtilla and is not bifurcated in the middle; this is a unique character of *S. puguensis* sp. nov. Furthermore, both males of *S. puguensis* sp. nov. have a very contrasting forewing pattern and an olive-buff ground-colour on the outer half of forewing; the latter is short and broad in *S. pwaniensis* sp. nov., its forewing is more elongated and cream-buff, and hence, more light brownish.

Distribution. *Shimbania puguensis* sp. nov. is known only from two lowland coastal forests that belong to the Zanzibar-Inhambane regional mosaic. A map based on forest data of the year 1970 and presented by Hawthorne (1984) shows that the Pugu Hills forest assemblages, including Kisarawe forest, were once largely connected, but much of this forest area has been destroyed until 1981 for plantations and mining for Kaolin as Hawthorne noted when he did his field studies in this area. Some forest patches disappeared (*e.g.*, Kikoka Forest Reserve, Vikindu Forest Reserve) others are patchy, particularly north of Kisarawe town, and south as well as north of the railway line to Dar es-Salaam, the latter town is located *ca.* 10–15 km to the East. Based on its distribution, *S. puguensis* sp. nov. can be classified as a lowland species that is endemic to the Pugu Hills forests, including Kisarawe Forest, most probably also to Kazimzumbwi Forest Reserve (*ca.* 6–10 km southwest of Kisarawe town). These forests are located in the Usaramo floristic area *sensu* Hawthorne (1984).

Etymology. *Shimbania puguensis* is named for the Pugu Hills (Tanzania), an escarpment (altitude 93–310 m) that is built mainly of "Pugu sandstone" and other Neogene sediments (Tertiary), extending from south of Kisarawe town NNE for *ca.* 10 km and comprises very different and diverse wetter and drier coastal forest types on ridge tops, slopes, valley bottoms, with swampy areas and riverine forests (Hawthorne 1984).

The gender of the new species name is feminine.

Shimbania kaguruensis sp. nov.

https://zoobank.org/68055FAD-16E4-47DE-A6F5-53E86596920E

Figs 2c, 9b

Material examined. ***Holotype*** male, Tanzania, Morogoro Region, Kaguru Mountains [also called Ukaguru Mountains], "forêt alt.: 1900 m" [> 1.800 m = upper montane forest, *cf.* Pócs 1976], 26 April 2005, Ph. Darge [leg.], genitalia slide number 05/122008 I. Lehmann (MWM).

Description. ***Head*:** ventrally brownish-olive (without any chestnut colour), the rest is pale olive-buff (*cf. puguensis* sp. nov. and *pwaniensis* sp. nov. that have dark chestnut scales on the head), short scales with cream tips, not glossy; eyes light brown-olive with few small black spots and surrounded by long hair-like scales of brownish-olive ventrally without a glint; a pair of pits is rudimentary on lower fronto-clypeus; pits behind labial palpi are slits; antenna short, 0.30 length of forewing, bipectinate, shaft narrow, branches long with 4.5× width of shaft, not scaled, all branches are widely separated at

base, at least 2× width of branch; shaft densely covered with ivory-yellow scales dorsally; labial palpi long, almost as long as eye-diameter, buffy-olive.

***Thorax*:** Patagia pale olive-buff, forming a collar ring, few scales with light grey tips; tegulae with long hair-like brownish-olive scales (without any chestnut colour), glossy. Metathorax has a crest of pale olive-buff scales with brownish-olive center. Hind legs pale olive-buff with fine hair-like scales with light grey tips, on lower part of tarsus brownish-olive dorsally; two pairs of tibial spurs of unequal width and length, upper pair narrow *ca.* 1.0 mm and 1.2 mm, lower pair slightly broader and *ca.* 0.9 mm and 1.1 mm long. Forewing length 21.0 mm and wingspan is 44.0 mm in holotype. The whole forewing upperside is pale olive-buff with a light golden glint; below first half of 1A+2A a weak brownish-olive patch; forewing with few weak narrow dark olive lines from costa to dorsum, veins not distinctly marked; a large and deep olive subterminal patch, broadly oval-shaped, from R_4 to near middle of CuA_1; termen without lunules; cilia short, 1.0 mm, pale olive-buff with grey tips. Underside of forewing is cream-buff with weak brownish-olive lines and a golden glint. Hindwing upperside is pale olive-buff with a light golden glint; cilia as in forewing; underside as in forewing.

***Abdomen*:** Pale olive-buff mixed with ivory-yellow hair-like scales with a glint; abdominal tuft with hair-like scales of pale olive-buff and ivory-yellow, medium long, 1/4 length of abdomen. Genitalia with long uncus, 70% of length of whole gnathos, narrow graben-like surface ventrally absent. Gnathos has gnathos arms that are large, one arm 30% the size of valva; upper part of the gnathos arm is a long band, as long as 65% of basal width of valva, the lower part of the gnathal arm does not touch the other arm, it is of broad triangular shape with a pronounced thorn-like structure and with its base 50% of the basal width of valva, a strongly serrate dorsal edge is present; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 25% of the transtilla and is widely bifurcated at the middle. The Gnathos arms end above the dorsal edge of the transtilla. The valva is broadly triangular with a dorsal edge of 2.0× the length of uncus, ventral edge of valva slightly S-shaped with a tip that is broadly pointed; sacculus not pronounced, short and narrow, sclerotized, 30% of length of ventral edge of valva; juxta well developed, with two broadly rounded lobes and a narrowly V-shaped emargination in between is 80% the length of juxta, tips of lobes broadly rounded. Phallus unknown (broken near its basal end).

Female. Unknown.

Diagnosis. *Shimbania kaguruensis* sp. nov. can be separated from all other congeners by its small wing size, the shortest antennae (also in relation to the forewing length) among all species presented here with a remarkable narrow shaft and widely separated long narrow branches; the genitalia is similar to *S. pwaniensis* sp. nov., both species share two characters in common, namely the absence of a graben-like surface on the uncus ventrally and the wavy shape of the upper part of vinculum (but not on the ventral part like in *S. pwaniensis* sp. nov.). The shape of vinculum (viewed ventrally) is very rounded in *S. kaguruensis* sp. nov., but broadly oval in *S. pwaniensis* sp. nov. In the latter species, the larger gnathal arms are of triangular shape and have only one thorn-like appendice in front of an entirely straight dorsal edge while in *S. kaguruensis* sp. nov. the gnathal arms bear a long and a small thorn-like appendice in front of a strongly serrate dorsal edge. Furthermore, *S. pwaniensis* sp. nov. has a very contrasting and much darker forewing pattern with a larger subterminal patch; its forewing is also more elongated. Nevertheless, due to the common characters in the male genitalia mentioned above, a closely related species of *S. kaguruensis* sp. nov. is *S. pwaniensis* sp. nov.

Distribution. *Shimbania kaguruensis* sp. nov. is known from an upper montane forest at 1.900 m in the Kaguru Mountains, the highest altitude recorded for any species of *Shimbania* (*cf.* the closely related *S. pwaniensis* sp. nov. that is recorded from an altitude of 37 m). Noteworthy, the upper montane forests (> 1.800 m altitude) of the Kaguru Mountains have the most endemic-rich flora (Lovett 1998) if compared to the forests below an altitude of 1.800 m. The Kaguru Mountains belong to the "central Eastern Arc Mountains" (Lovett 1998) and are located *ca.* 220 km inland from the Indian Ocean coastline comprising a natural forest area of 184 km^2 (Newmark 2002) with an altitudinal range of montane forest from 1.500–2.250 m (Burgess et al. 1998). *Shimbania kaguruensis* sp. nov. is classified here as a montane forest species of drier forest that is endemic to the central Eastern Arc Mountains, in particular to the Kaguru Mountains, and occurs also most probably, *e.g.* in the Rubeho Mountains to the Southwest, in the Kiboriana Mountains to the West and in the Nguru Mountains to the Northeast. Since 90% of the original natural forest cover is already lost in the Kaguru Mountains (Newmark 2002), *S. kaguruensis* sp. nov. is potentially threatened.

Etymology. *Shimbania kaguruensis* is named for the Kaguru Mountains (Tanzania) that are among the three least scientifically studied Eastern Arc Mountains and among the two mountains with the highest losses of original forest cover in the last 200 years (90%) and among the four mountains with the most pronounced dry season (Newmark 2002).

The gender of the new species name is feminine.

Shimbania mbarikaensis sp. nov.

https://zoobank.org/B95DD0B6-842E-4806-B9C1-8C1410272506

Figs 2d, 9c

Material examined. ***Holotype*** male, Tanzania, Morogoro Region, Mbarika Mountains [also called Mbaraka Mountains, *cf.* Kielland 1990], "sud de Mahenge forêt" [= south of Mahenge Forest], 775 m, 22.April 2005, Ph. Darge [leg.], genitalia slide number 01/032009 I. Lehmann (MWM). ***Paratype*** male, same locality, "nr.

Mahenge Forest" [near Mahenge Forest], 775 m, 22.–23. April 2005, R. Minetti [leg.], genitalia slide number 023/072016 I. Lehmann (RMCA).

Description. Male. ***Head*****:** ventrally dark-olive (without any chestnut colour), the rest is deep olive-buff, short scales with cream tips, glossy; eyes light brownish-olive with few small black spots and surrounded by long hair-like scales of dark-olive ventrally with a glint; a pair of pits is rudimentary on lower fronto-clypeus, a pair of rudimentary projections also present; pits behind labial palpi are narrow slits; antenna long, 0.41 length of forewing, bipectinate, shaft broad, branches long, 3.0× width of shaft, not scaled, all branches are widely separated at base, but only 1.0× width of branch (*cf. kaguruensis* sp. nov.); shaft covered with ivory-yellow scales dorsally; labial palpi long, almost as long as eye-diameter, deep olive-buff.

Thorax**:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips; tegulae with long hair-like dark chestnut scales with a light lilac glint. Metathorax have a scale-crest of deep olive-buff with a dark chestnut center. Hind legs deep olive-buff with fine hair-like scales with light grey tips, on lower part of tarsus dark olive dorsally; two pairs of long tibial spurs of unequal width and length, upper pair narrow *ca.* 1.9 mm and 2.1 mm, lower pair broader *ca.* 1.9 mm and 1.8 mm long. Forewing length 23.0 mm (22.0 mm in paratype) and wingspan is 49.0 mm (48.0 mm in paratype). Forewing upperside deep olive-buff with a light golden glint, only costal margin citrine-drab; below first half of 1A+2A a sepia patch; forewing with many narrow dark olive lines from costa to dorsum, most veins distinctly marked sepia including CuA_2; a large and dark olive subterminal patch, broadly V-shaped, from R_3 to near end of CuA_1; termen without lunules; cilia short, 1.0 mm, deep olive-buff with grey tips and a glint. Underside of forewing is deep olive-buff with weak brownish-olive lines, citrine-drab along costa and a golden glint. Hindwing upperside is pale olive-buff with a light golden glint and weak brownish-olive lines; cilia as in forewing; underside as in forewing.

Abdomen**:** Deep olive-buff mixed with ivory-yellow hair-like scales with a light golden glint; abdominal tuft with hair-like scales of deep olive-buff and ivory-yellow, medium long, 1/4 length of abdomen. Genitalia with long uncus, 60% of length of whole gnathos, narrow graben-like surface ventrally is absent. Gnathos has gnathos arms that are large, one arm 45% the size of valva; upper part of the gnathos arm is a long band as long as 70% of basal width of valva, the lower part of the gnathal arm does not touch the other arm, it is of broad rectangular shape with a pronounced thorn-like structure and with its base 65% of the basal width of valva, a strongly serrate dorsal edge with two short thorn-like structures is present; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 20% of the transtilla and is widely bifurcated at the middle (also in paratype). The Gnathos arms end above the dorsal edge of the transtilla. The valva is broadly rectangular with a dorsal edge of 2.0× the length of uncus, ventral edge of valva oblique, almost C-shaped (also in paratype), not S-shaped, with a tip that is broadly rectangular; sacculus not pronounced, broad, weakly sclerotized, 45% of length of ventral edge of valva; juxta well developed, with two ear-shaped lobes and a narrowly V-shaped emargination in between that is 60% the length of juxta, tips of lobes rounded. Phallus very large, as broad as 40% of basal width of valva and 40% longer than costal width of valva, strongly S-shaped and bent upwards at tip distally, vesica without cornuti.

Female. Unknown.

Diagnosis. *Shimbania mbarikaensis* sp. nov. can be separated from all other congeners by its shape of the valvae that are broadly rectangular and elongated with an oblique ventral edge that is almost C-shaped and is not suddenly bent inwards. This shape of the valvae is similar to *S. baginerichardi* sp. nov., but in the latter species, the valvae are short with a dorsal edge of only 1.3× the length of uncus while in *S. mbarikaensis* sp. nov. the dorsal edge is 2× the length of uncus (the uncus has the same length in both species). Both species differ in the width of the tegumen (viewed ventrally) that is only 30% as broad as the basal width of valva in *S. mbarikaensis* sp. nov. but 50% as broad as the basal width of valva in *S. baginerichardi* sp. nov. The dark-olive as well as deep olive-buff head (without any chestnut colour) is remarkable and differs to *S. puguensis* sp. nov. and *S. pwaniensis* sp. nov. that have mainly dark chestnut scales on the head.

Distribution. *Shimbania mbarikaensis* sp. nov. is only known from an submontane habitat south of Mahenge Forest. Kielland (1990) described the "Mbaraka" (= Mbarika) Mountains as seen from Muhulu Forest (located south of Mahenge Forest at 8°49'57"S, 36°39'32"E) as "uninhabited … several patches of forest on hilltops". The Mbarika-Mahenge mountain chain belongs to the "southern Eastern Arc Mountains" (Lovett 1998) and is located *ca.* 290–300 km inland from the coast of the Indian Ocean. The isolated forest patches on hilltops as seen by Jan Kielland have high species diversities as well as species of restricted distribution, *e.g.* trees like *Allanblackia stuhlmannii* Engl. (Guttiferae) and *Dombeya amaniensis* Engl. (Sterculiaceae). The forests are edged by woodland with scattered trees, *e.g. Combretum molle* R. Br. (Combretaceae) and *Erythrina abyssinica* Lam. (Leguminosae-Papilionaceae) (CELP 2007). The altitudinal range of submontane forest is from *ca.* 700–1.300 m; montane forest from 1.300 m – *ca.* 1.477 m. The Mbarika-Mahenge mountain chain is among the four Eastern Arc Mountains with the most pronounced dry season. Hence, *Shimbania mbarikaensis* sp. nov. is classified here as a submontane species of drier forest and/or woodland that is endemic to the Mahenge-Mbarika mountain chain (altitude up to 1.496 m; combined forest cover of all patches 291 km^2 with very little closed forest *cf.* Newmark 2002). Due to the small size of all forest patches on this mountain chain *S. mbarikaensis* sp. nov. is potentially threatened.

Etymology. *Shimbania mbarikaensis* is named for the Mbarika-Mahenge mountain chain (Tanzania) that is the

least scientifically studied among the Eastern Arc Mountains, and is among the three mountains with the highest losses of original forest cover in the last 200 years (89.3%) (Newmark 2002).

The gender of the new species name is feminine.

Shimbania kerstinhempae sp. nov.

https://zoobank.org/A315E13F-43E5-4B62-8721-05996E3619A5

Figs 2e, 6a, 7c; fig. 52 in Lehmann (2019b)

Material examined. ***Holotype*** female, Tanzania, [Arusha Region], Arumeru District, Usa River [Danish Volunteer Training Centre], 1.170 m [altitude at this site is 1.198–1.225 m], 06 February 1992, L. Aarvik [leg.], genitalia slide number 27/062009 I. Lehmann (NHMO).

Description. Female. ***Head*****:** deep olive-buff, short hair-like scales with cream tips; eyes light olive-brown; a pair of tiny pits is present on lower fronto-clypeus; pits behind labial palpi are small oval; antenna short, 0.28 length of forewing, bipectinate, branches shorter than in males, 2.5× width of shaft, narrow, not scaled, widely separated at base, 1.5× width of branch; shaft densely covered with olive-buff scales dorsally; labial palpi deep olive-buff.

Thorax**:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips, but without a glint; tegulae with long hair-like sepia scales without a glint. Metathorax has a small scale-crest of olive-buff and cream and sepia at center. Hind legs olive-buff with fine hair-like scales with light grey tips mixed with cream scales, on lower part of tarsus only deep olive-buff dorsally; two pairs of long tibial spurs of unequal width and length, upper pair long *ca.* 2.0 mm and 1.6 mm, lower pair broader *ca.* 1.2 mm and 1.0 mm long. Forewing length 21.5 mm and wingspan 48.0 mm in holotype. Forewing upperside largely olive-buff and on outer half with a light golden glint; below first 2/3 of 1A+2A a large sepia patch with a weak lilac glint; forewing with many narrow deep olive-buff lines, CuA_2 narrowly sepia and extending as sepia streak into discal cell; a deep olive subterminal patch, Y-shaped, from below costal margin to near end of CuA_2; costa and termen without striae or lunules; cilia very long, 2.0 mm, deep-olive buff with cream tips. Underside of forewing olive-buff with a golden glint. Hindwing upperside is olive-buff with a light golden glint and with weak deep olive lines; cilia as in forewing; underside as in forewing.

Abdomen**:** Mainly olive-buff mixed with cream, glossy; abdominal tuft olive-buff, medium long, 1/4 length of abdomen. Postabdominal structure with a medium large, narrow papillae anales, with many short setae, lobes of papillae anales narrow, small for such a large species, 35% the size of papillae anales with some long setae towards the tip of each lobe; segment 8 rectangular with a broader dorsal edge, posterior margin with long setae, ventral part narrower with many long setae; an oblique row of long setae from the posterior dorsal part of segment 8 towards near its ventral part; attached to the ventral end of segment 8 is a narrow sclerotized band that is connected with the base of the anterior apophysis; anterior apophysis narrow, almost twice as long as posterior apophysis, broader at base, almost knee-like; posterior apophysis narrow with a long, broad tip, resembling a spoon-like shape if not pressed, the extremely large sclerotized base of the posterior apophysis is 40% the size of the papillae anales in lateral view. Corpus bursae and ductus bursae are unknown.

Male. Unknown.

Diagnosis. *Shimbania kerstinhempae* sp. nov. can be separated from all other congeners by the very broad dorsal part of segment 8 (almost as broad as the length of anterior apophysis) and the oblique row of long setae that occurs from the posterior dorsal part of segment 8 towards near its anterior ventral part. The lobes of the papillae anales are larger if compared to *S. durbanica* and *S. nigeriaensis* sp. nov. One common character of all females in the three species is the large sclerotized base of the posterior apophysis.

Distribution. *Shimbania kerstinhempae* sp. nov. is only known from Usa River. The collecting site is located in the transition zone of the Somalia-Masai regional centre of endemism and the Afromontane archipelago-like regional centre of endemism comprising an Afromontane forest patch, stands with trees of *Acacia* MILL. (Leguminosae-Mimosoideae) and some ornamental and fruit trees, *e.g.*, *Jacaranda mimosifolia* D. Don. (Bignoniaceae) and *Kigelia africana* Benth. (Bignoniaceae) (Leif Aarvik pers. comm. to I.L. 2013). Due to the transitional character of the habitat with forest as well as woodland patches, *S. kerstinhempae* sp. nov. most probably occurs also in other similar habitats near Mount Meru and extends its range towards the montane areas of Mount Kilimanjaro.

Etymology. *Shimbania kerstinhempae* sp. nov. is named for Kerstin Hemp, a young botanist, who published recently the first book on the medicinal plants of Mount Kilimanjaro (Hemp et al. 2020) based on her own field studies during her stay at the United World College Moshi (Tanzania) in collaboration with Haika Mkunde and Eliasi Maruchu from the Chagga tribe.

The gender of the new species name is feminine.

Shimbania wanjakinuthiaae sp. nov.

https://zoobank.org/C41EACE6-7A7F-4C9B-8E8A-B8A74D46EE0D

Figs 3a, 9d

Material examined. ***Holotype*** male, Republic of South Africa, Province KwaZulu-Natal, 5 km north of Hluhluwe, 27°59'[23"]S, 32°16'[13"]E, [86 m], "Hluhluwe Farm?", "legit unknown", "recd [received] ex Williams M." [from Mark Williams to TMSA], 31.October 1974, genitalia slide number 012c/062016 I. Lehmann (TMSA).

Description. ***Head*****:** ventrally sepia (without any chestnut colour), the rest is deep olive-buff, short scales with cream tips, glossy; eyes sepia with many small dark brown spots and surrounded by long hair-like scales of

Figure 3. a. *Shimbania wanjakinuthiaae* sp. nov., holotype, male, Republic of South Africa, Province KwaZulu-Natal, ca. 5 km north of Hluhluwe, probably collected on Hluhluwe Farm; **b.** *S. durbanica* (Hampson, 1910), comb. nov., male, Republic of South Africa, Province KwaZulu-Natal, Durban; **c.** *S. durbanica* (Hampson, 1910), comb. nov., female, Republic of South Africa, Province KwaZulu-Natal, Durban; **d.** *S. krooni* sp. nov., holotype, male, Republic of South Africa, Province Eastern Cape, Port St. Johns; **e.** *S. wichgrafi* (Grünberg, 1910), comb. nov., „Type“, male, Republic of South Africa, Province Gauteng, Pretoria or Johannesburg; **f.** *S. nigeriaensis* sp. nov., holotype, female, Nigeria, locality unknown, probably collected at the coast as “1 m“ on the label might represent the altitude.

sepia with a glint; a pair of pits is rudimentary on lower fronto-clypeus, a pair of projections absent; pits behind labial palpi are extremely tiny narrow slits; antenna medium long, 0.37 length of forewing, bipectinate, shaft narrow, branches long, 3.5× width of shaft, not scaled, all branches are widely separated at base, 1.5× width of branch; shaft covered with ivory-yellow scales dorsally; labial palpi long, almost as long as eye-diameter, sepia.

***Thorax*:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips; tegulae with long hair-like

dark chestnut scales with a light lilac glint. Metathorax has a scale-crest of deep olive-buff with a small patch of dark chestnut at center. Hind legs deep olive-buff with fine hair-like scales with light grey tips, on lower part of tarsus dark chestnut dorsally; two pairs of short tibial spurs (*cf. mbarikaensis* sp. nov.) of unequal width and length, upper pair broad, *ca.* 1.7 mm and 1.0 mm long, lower pair narrow *ca.* 1.2 mm and 0.8 mm long. Forewing length 21.0 mm and wingspan is 45.0 mm. Forewing upperside deep olive-buff with a light golden glint towards termen, costal margin not distinctly marked; below first half of 1A+2A a dark chestnut patch; forewing with few and weak, narrow, dark olive lines from costa to dorsum, most veins distinctly marked dark olive including CuA_2; a small, weak and dark olive subterminal patch, oval-shaped, from R_3 to near end of CuA_2 and hence, with a long stalk; termen without lunules; cilia short, 1.0 mm, deep olive-buff with grey tips and a glint. Underside of forewing is olive-buff with a golden glint. Hindwing upperside is pale olive-buff with a light golden glint; cilia as in forewing; underside as in forewing.

***Abdomen*:** Deep olive-buff with hair-like scales with a light golden glint; abdominal tuft with hair-like scales of deep olive-buff, short, 1/5 length of abdomen. Genitalia with very long and narrow uncus, 80% of length of whole gnathos, narrow graben-like surface ventrally is absent, but a thickening occurs behind the tip ventrally. Gnathos has gnathos arms that are large, one arm 50% the size of valva; upper part of the gnathos arm is a short band that is only as long as 30% of basal width of valva, the lower part of the gnathal arm does not touch the other arm but is widely separated, it is of broad rectangular shape with a pronounced thorn-like structure and with its base 40% of the basal width of valva, a strongly serrate dorsal edge is absent, but two short thorn-like structures are present; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 20% of the transtilla and is narrowly bifurcated at the middle. The Gnathos arms end above the dorsal edge of the transtilla. The valva is short, broadly rectangular with a dorsal edge of 1.4× the length of uncus, ventral edge of valva oblique C-shaped, with a tip that is broadly rounded; sacculus not pronounced, narrow, weakly sclerotized, 40% of length of ventral edge of valva; juxta well developed, with two oval-shaped lobes and a narrowly V-shaped emargination in between that is only 30% the length of juxta, tips of lobes pointed. Phallus large, as broad as 30% of basal width of valva and 45% longer than costal width of valva, bent upwards at tip distally, vesica without cornuti.

Female. Unknown.

Diagnosis. *Shimbania wanjakinuthiaae* sp. nov. is a small species with a similar size to *S. kaguruensis* sp. nov. Apart from the size, the genitalia is most similar to *S. budaensis* sp. nov. with a very broad ventral base of the vinculum, but in *S. wanjakinuthiaae* sp. nov. it has 55% of the basal width of its short valva and hence, is at present the broadest ventral base of a vinculum among *Shimbania*. The latter species can also be easily separated from *S. budaensis* sp. nov. by its short rectangular valva with a costal margin that is only 1.4× longer than the uncus and with a ventral margin that is not suddenly bent inwards but C-shaped (*cf.* diagnosis of *S. budaensis* sp. nov.). The shape of the valvae is similar to *S. baginerichardi* sp. nov., in the latter species, the valvae are also short with a dorsal edge of only 1.3× the length of uncus while in *S. wanjakinuthiaae* sp. nov. the dorsal edge is 1.4× the length of uncus. However, the former species is larger with a more contrasting wing pattern. Both species differ in the width of the tegumen (viewed ventrally) that is 40% as broad as the basal width of valva in *S. wanjakinuthiaae* sp. nov. but 50% as broad as the basal width of valva in *S. baginerichardi* sp. nov. Additionally, the latter species has a narrow ventral base of the vinculum. Due to the common characters in the male genitalia mentioned above, two closely related species of *S. wanjakinuthiaae* sp. nov. occur at present in coastal forests of southeast Kenya, but not nearby since the size, shape of valvae and vinculum separate *S. wanjakinuthiaae* sp. nov. from the other three species of *Shimbania* that are presented herein from the Republic of South Africa.

Distribution. *Shimbania wanjakinuthiaae* sp. nov. is only known from a drier lowland area *ca.* 5 km north of Hluhluwe, located *ca.* 32 km inland from the coast of the Indian Ocean and just 2 km west of Lake St. Lucia, with a mosaic of various habitats. Rutherford et al. (2006) described the area just east and northeast of Hluhluwe as "Makatini Clay Thicket" (Savanna Biome) adjacent to the "Zululand Lowveld" (Savanna Biome) that largely occurs towards the west and north of Hluhluwe including remarkable continuous bands of "Lowveld Riverine Forest" (Azonal Forests of the Forests Biome) *sensu* Mucina and Geldenhuys (2006). The latter occur near the collecting site. It is a tall, "critically endangered" forest comprising, *e.g. Acacia robusta* Burch subsp. *clavigera* Brenan (Leguminosae-Mimosoideae), *Diospyros mespiliformis* Hochst. (Ebenaceae) and *Faidherbia albida* (Delile) A. Chev. (Leguminosae-Mimosoideae), and is located adjacent to areas of cultivation as well as dense thickets of the "Zululand Lowveld" with, *e.g. Dichrostachys cinerea* (L.) Wight & Arn. (Leguminosae-Mimosoideae) and various *Acacia* spp. (Leguminosae-Mimosoideae). *Shimbania wanjakinuthiaae* sp. nov. most probably extends via riverine forests further to the East into the "Maputaland Coastal Belt" *sensu* Mucina et al. (2006b), occurring along the coast of the Indian Ocean, in habitats with average annual rainfall of 1200 mm that decreases rapidly towards areas near Hluhluwe with 500 mm. Due to the small size of all forest patches on these areas *S. wanjakinuthiaae* sp. nov. is potentially threatened.

Etymology. *Shimbania wanjakinuthiaae* is named for the Kenyan Senior Research Scientist Dr. Margaret Wanja Kinuthia (NMK, Invertebrate Zoology Section, Nairobi) for her significant support on research permits from the Government of Kenya for I.L. to undertake field work in five coastal forests of Kwale District in the years 2000–2005. Wanja works as an entomologist in the NMK since 1998 and was among Kenyan Scientists who coordinated the "BIOTA East" project (BIOdiversity Monitoring

Transect Analysis in Africa, undertaken in Kenya, Uganda and Yemen) since 2001 for nine years. The project significantly increased taxonomic capacity to identify invertebrates, plants and microorganisms in East Africa. She still supports various scientific studies as well as awareness raising projects on the impact of pesticide on bees and other pollinators in farmlands and natural landscapes in the frame of the FAO and GEF "Global Pollination Project" in Kenya, Ghana and in the Republic of South Africa.

The gender of the new species name is feminine.

Shimbania durbanica (Hampson, 1910) comb. nov.

Figs 3b, c, 10A, C

Lebedodes durbanica Hampson, 1910: Annals and Magazine of Natural History, Ser. 8, Vol. VI, July 1910, 118–119: "Hab. Natal, Durban (*Leigh, Bowker, Quekett*), 5 ♂ type." [no date published but ex own data of I.L. the type in BMNH is labelled as follows: "Durban, 08. March 1907, G.F. Leigh, B.M. 1909—71"]. Original combination.

Material examined. Male, [Republic of South Africa], [Province KwaZulu-Natal], Durban, no date, Clark [leg.], genitalia slide number 12b/062009 I. Lehmann (NRM); male, [Republic of South Africa], [Province KwaZulu-Natal], Stanger, February 1958, Miss C. Schulz [leg.], genitalia slide number 31/122008 I. Lehmann (NMK); male, [Republic of South Africa], [Province KwaZulu-Natal], "Verulam, Natal", no date, [A.J.] Spiller [leg.], on a second label in handwriting "Staudinger K.7 43." [hence, collected most probably well before October 1900 when Dr. Otto Staudinger died], genitalia slide number 12/062009 I. Lehmann (ZMHU); female, [Republic of South Africa], [Province KwaZulu-Natal], "Natal, Durban", 12. December 84 [1884], G. Leigh [leg.], "19 ex-coll. CH. Oberthur [Charles Oberthür], R. Biedermann ded. [delivered?] Muséum Paris", another label indicates "Coll. R. Biedermann [number] 287", genitalia slide number 01/092020 I. Lehmann (MNHN); female, [Republic of South Africa], [Province KwaZulu-Natal], Durban, December 1905, A.T. Cuotte [?], [leg.], genitalia slide number 22/032021 I. Lehmann (NRM).

Re-description. Male (ex NRM). ***Head*:** ventrally sepia (without any chestnut colour), the rest is deep olive-buff, short scales with cream tips, glossy; eyes black without spots and surrounded by long hair-like scales of sepia with a glint; a pair of pits is present on lower fronto-clypeus, a pair of projections absent; pits behind labial palpi are extremely narrow slits; antenna long, 0.44 length of forewing (0.42 in males from Verulam and Stanger), bipectinate, branches long, 4.0× width of shaft, not scaled, all branches are widely separated at base, 1.5× width of branch; shaft covered with ivory-yellow scales dorsally; labial palpi long, slightly longer than half of eye-diameter, sepia.

***Thorax*:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips; tegulae with long hair-like dark chestnut scales with a light lilac-golden glint. Metathorax with scale-crest of deep olive-buff with a small patch of dark chestnut at center. Hind legs deep olive-buff with fine hair-like scales with light grey tips, on lower part of tarsus light brown dorsally; two pairs of short tibial spurs (*cf. mbarikaensis* sp. nov.) of unequal width and length, upper pair broad, *ca.* 1.7 mm and 1.1 mm long, lower pair of spurs narrow, *ca.* 1.4 mm and 0.9 mm long. Forewing length 18.0 mm and wingspan is 41.0 mm (42.0 mm in male from Verulam, 42.5 mm in male from Stanger). Forewing upperside deep olive-buff with a light golden glint towards termen, costal margin not distinctly marked; below first half of 1A+2A a dark chestnut patch; forewing with weak, very narrow and dark olive lines from costa to dorsum, veins not distinctly marked, except CuA_2 which is narrowly dark olive; a small, weak and dark olive, nearly "Y"-shaped subterminal patch, oval, from R_3 to near end of CuA_2 and hence, with a long stalk (also in male from Verulam and Stanger); termen without lunules; cilia short, 0.9 mm, deep olive-buff with a glint. Underside of forewing is olive-buff with a golden glint. Hindwing upperside is pale olive-buff with a light golden glint; cilia as in forewing; underside as in forewing.

***Abdomen*:** Deep olive-buff with hair-like scales with a light golden glint; abdominal tuft with hair-like scales of deep olive-buff, short, 1/5 length of abdomen. Genitalia with very long and narrow uncus, 80% of length of whole gnathos, narrow graben-like surface ventrally is present and well visible (in three males). Gnathos has gnathos arms that are large, one arm 40% the size of valva; upper part of the gnathos arm is a short band that is only as long as 30% of basal width of valva, the lower part of the gnathal arm does touch the other arm and both are overlapping, it is of broad triangular shape with a pronounced thorn-like structure and with its base 60% of the basal width of valva, but a strongly serrate dorsal edge as well as short thorn-like structures are absent (in three males); the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 20% of the transtilla and is widely bifurcated at the middle. The Gnathos arms end above the dorsal edge of the transtilla. The valva (in three males) is elongated, broadly rectangular with a dorsal edge of 2.0× the length of uncus, ventral edge of valva not or only slightly bent inwards at half of ventral edge, with a tip that is broadly rounded; sacculus not pronounced, narrow, weakly sclerotized, short, 30% of length of ventral edge of valva; juxta well developed, with two ear-shaped lobes and a narrowly V-shaped emargination in between that is 60% the length of juxta, tips of lobes rounded. Phallus large, as broad as 30% of basal width of valva and 20% longer than costal width of valva, bent upwards at tip distally, vesica without cornuti.

Description. Female (ex NRM). ***Head*:** deep olive-buff (without any chestnut colour), short scales with or without cream tips, slightly glossy; eyes dark olive with few black spots and surrounded by long hair-like scales of light brown and deep olive-buff with a weak glint; a pair of pits is absent on lower fronto-clypeus, a pair of well visible projections is present on fronto-clypeus (in both females); pits behind labial palpi are narrow oval-shaped

holes; antenna short, 0.34 length of forewing, bipectinate, branches long, 3.5× width of shaft, not scaled, all branches are widely separated at base, 2.0× width of branch; shaft covered with cream scales dorsally; labial palpi long, slightly longer than half of eye-diameter, light brown.

***Thorax*:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips; tegulae with long hair-like dark chestnut scales with a weak lilac glint. Metathorax with a crest of deep olive-buff scales mixed with ivory-yellow scales, with a small patch of light brown at center. Hind legs deep olive-buff with fine hair-like scales, some with light grey tips, on lower part of tarsus light brown dorsally; two pairs of long tibial spurs (*cf. mbarikaensis* sp. nov.) of unequal width and length, upper pair broad, *ca.* 2.1 mm and 1.9 mm long, lower pair of spurs narrow, *ca.* 1.7 mm and 1.1 mm long (in both females). Forewing length 19.0 mm and wingspan is 44.0 mm. Forewing upperside deep olive-buff with a light golden-lilac glint towards termen, costal margin not distinctly marked; below first half of 1A+2A a dark chestnut patch; forewing largely without any dark olive lines, veins not distinctly marked, except CuA_2 which is narrowly dark olive, but only weakly marked; a small, weak and dark olive subterminal patch, narrowly oval-shaped, from R_3 to near end of CuA_2 and hence, with a long stalk; termen without lunules; cilia long, 1.5 mm, deep olive-buff with a glint. Underside of forewing is olive-buff with a golden glint. Hindwing upperside is pale olive-buff with a light golden glint; cilia as in forewing; underside as in forewing.

***Abdomen*:** Mainly olive-buff mixed with cream, glossy; abdominal tuft olive-buff, medium long, 1/4 length of abdomen. Postabdominal structure and genitalia: with a small, narrow papillae anales, not broader than base of posterior apophysis, with many short and long setae, lobes of papillae anales very small for such a large species, 20% of size of papillae anales with some long setae towards the tip of each lobe; segment 8 broadly rectangular with broader dorsal edge, posterior margin with two rows of long setae (up to 70% as long as the dorsal part of segment 8), ventral part narrower, also with many long setae; an oblique row of long setae is absent on segment 8 (*cf. S. kerstinhempae* sp. nov.); attached to the ventral end of segment 8 is a narrow sclerotized band that is connected with the base of the anterior apophysis; anterior apophysis narrow, 2.1× longer than posterior apophysis, broader at base, straight, not bent; posterior apophyses narrow with a broader tip, the extremely large sclerotized base of the posterior apophysis is half the size of the papillae anales in lateral view. Ductus bursae very long, 3× as long as dorsal width of segment 8, thinly membranous and narrow. The corpus bursae large, 2× the size of segment 8 in lateral view, elongated oval-shaped, thinly membranous and without any structures (Fig. 10C).

Diagnosis. *Shimbania durbanica* is a small species in both sexes, and if compared to species of *Shimbania* occurring north of the Limpopo River, it is only slightly larger than *S. kaguruensis* sp. nov. Apart from the size, the male genitalia of *S. durbanica* has a unique character, namely a very broad tegumen which is broader than the length of the upper band-like structure of the gnathos, representing the broadest tegumen among all species of *Shimbania* presented herein. Other characters in the male genitalia are most similar to a species that occurs in Tanzania, namely *S. pwaniensis* sp. nov. Both species have a large triangular lower part of gnathos that has only one thorn-like appendice and an elongated, rectangular valva that has a dorsal edge of 2.0× the length of uncus. The tip of valva is slightly pointed in the latter species but broadly rounded in *S. durbanica*. Further differences between both species are the width of the uncus that is 2.0× as broad in *S. pwaniensis* sp. nov. as in *S. durbanica*. Additionally, the former species has a broad and wavy-shaped ventral base of the vinculum. The female genitalia and postabdominal structure can be separated from all other congeners by the narrow dorsal part of segment 8 if compared to the length of the anterior apophysis that is 2.0× longer than segment 8 dorsally, the extremely large sclerotized base of the posterior apophysis that is half the size of the papillae anales in lateral view and a very long ductus bursae that is 3.0× as long as the dorsal width of segment 8 and is among the longest in Metarbelidae.

Distribution. *Shimbania durbanica* is known from areas in and around Durban (altitude 2–145 m) extending its range via Verulam (altitude 23–292 m) to Stanger (altitude 23–219 m), located *ca.* 27 km and *ca.* 60 km north of Durban, and hence, from habitats near the coastline of the Indian Ocean up to *ca.* 16 km further inland. All habitats of *S. durbanica* belong to the "KwaZulu-Natal Coastal Belt" *sensu* Mucina et al. (2006b) (Indian Ocean Coastal Belt Biome). One of the characters of this biome is the absence of an entirely rain-free (dry) period. The habitats are certainly highly dissected today due to large sugarcane fields, timber plantations and coastal holiday resorts but the areas mentioned above were once covered to a great extent by a subtropical "Northern Coastal Forest" *sensu* Mucina and Geldenhuys (2006) dominated by *Albizia adianthifolia* W.F. Wight (Leguminosae-Mimosoideae), *Drypetes natalensis* Hutch. (Euphorbiaceae), *Englerophytum natalense* T.D. Penn. (Sapotaceae) and mixed with, *e.g. Brachylaena discolor* DC. (Compositae) and *Mimusops caffra* E. Mey (Sapotaceae). The remnants of "Northern Coastal Forest" between Durban and Verulam towards around Stanger all have almost certainly a small size and are isolated today. Hence, like its habitat, *S. durbanica* is potentially threatened.

Based on its distribution, *S. durbanica* can be classified as a lowland species that is endemic to the "KwaZulu-Natal Coastal Belt" as part of the "Tongaland-Pondoland regional mosaic" *sensu* White (1983).

Shimbania krooni sp. nov.

https://zoobank.org/D58EF90A-CD76-44EE-A349-4D6F7A79FD27

Figs 3d, 10B

Material examined. Male, [Republic of South Africa], [Province Eastern Cape], Port St. Johns, 09. January

1973, D.M. Kroon [leg.], "Brit. Mus. 1975—587", genitalia slide number 07/022009 I. Lehmann (BMNH).

Description. ***Head*****:** entirely olive-brown with a light lilac glint; eyes olive-brown with black patches and surrounded by long hair-like scales of olive-brown with a light lilac glint; a pair of rudimentary pits is present on lower fronto-clypeus, a pair of projections is present and well visible on lower fronto-clypeus; pits behind labial palpi are extremely small slits; antenna short, 0.35 length of forewing, bipectinate, branches short, 3.0× width of shaft, not scaled, all branches are widely separated at base, 2.0× width of branch; shaft covered with ivory-yellow scales dorsally; labial palpi long, slightly longer than half of eye-diameter, olive-brown.

Thorax**:** Patagia olive-brown, forming a collar ring, scales without light grey tips; tegulae with long hair-like dark chestnut scales with a light lilac-golden glint. Metathorax with scale-crest of olive-brown with a small patch of dark chestnut at center. Hind legs olive-brown with fine hair-like scales with light grey tips, on lower part of tarsus deep olive-buff dorsally; two pairs of tibial spurs of unequal width and length, upper pair broad, *ca.* 1.4 mm and 1.0 mm long, lower pair narrow, *ca.* 1.1 mm and 0.9 mm long. Forewing length 21.5 mm and wingspan is 48.5 mm. Forewing upperside unusually dark, with dark chestnut mixed with citrine-drab on inner half of wing, outer half dark olive-buff with a light golden glint towards termen, costal margin distinctly marked greyish-olive; only below first one-third of 1A+2A a dark chestnut patch; veins not distinctly marked including CuA_2; the only pattern on forewing is a very weak (difficult to see) dark olive subterminal patch, nearly "Y"-shaped, narrowly oval, from R_3 to near end of CuA_1 and hence, with a short stalk, and a weak line almost parallel to termen from near apex to end of CuA_1; the termen is without lunules; cilia short, 1.0 mm, olive-brown with a glint. Underside of forewing is dark olive-buff with a golden glint. Hindwing upperside is dark olive-buff with a light golden glint; cilia as in forewing; underside as in forewing.

Abdomen**:** Dark olive-buff with hair-like scales with a light golden glint; abdominal tuft with hair-like scales of dark olive-buff, long, 1/3 length of abdomen. Genitalia with short and narrow uncus, 60% of length of whole gnathos, narrow graben-like surface ventrally is present. Gnathos has gnathos arms that are large, one arm 50% the size of valva; upper part of the gnathos arm is a long band that is as long as 50% of basal width of valva, the lower part of the gnathal arm does not touch the other arm, it is of broad triangular shape with a pronounced thorn-like structure and with its base 80% of the basal width of valva, but a strongly serrate dorsal edge as well as short thorn-like structures are absent; the gnathal arms are connected ventrally by a very narrow sclerotized band that is only as broad as 15% of the transtilla and is widely bifurcated at the middle. The Gnathos arms end above the dorsal edge of the transtilla. The valva is elongated, broadly triangular with a long dorsal edge of 2.4× the length of uncus, ventral edge of valva oblique, only slightly bent inwards at 2/3 of ventral edge, with a tip that is narrowly rounded; sacculus not pronounced, narrow, weakly sclerotized, short, 40% of length of ventral edge of valva; juxta well developed, with two broad rectangular lobes and a narrowly V-shaped emargination in between the lobes, it is 50% the length of juxta, dorsal edge of lobes straight. Phallus large, as broad as 40% of basal width of valva and 20% longer than costal width of valva, bent upwards at tip distally, vesica without cornuti.

Diagnosis. *Shimbania krooni* sp. nov. is the largest species of *Shimbania* in the Republic of South Africa and is among the darkest coloured species of *Shimbania* with almost no pattern on forewings. Veins R_1+R_2 originating from one of the longest stalks among *Shimbania*, the stalk has the length of 60% of R_3. Two unique characters occur in the genitalia, namely a short uncus (the dorsal edge of valva is 2.4× the length of uncus) and a juxta with broadly rectangular lobes. If compared to the other three species presented here from the Republic of South Africa the uncus is also the broadest. The very narrow upper half of vinculum and its narrow ventral part is only similar to *S. wichgrafi*. The differences are a thickening on the ventral part of the uncus and a very broad rounded distal edge of an rectangular and elongated valva, both present in *S. wichgrafi*, but absent in *S. krooni* sp. nov.

Distribution. *Shimbania krooni* sp. nov. is only known from an area in Port St. Johns (altitude 5–210 m), located at the coastline of the Indian Ocean up to *ca.* 1.5 km further inland. The habitats belong to the "Transkei Coastal Belt" *sensu* Mucina et al. (2006b) (Indian Ocean Coastal Belt Biome). One of the characters of this coastal belt is its highly dissected landscape with alternating hills and steep slopes. The habitats comprise grasslands with subtropical thicket clumps and scattered patches of "Scarp Forest" *sensu* Mucina and Geldenhuys (2006) dominated by, *e.g. Buxus natalensis* Hutch. (Buxaceae), *Heywoodia lucens* Sim (Phyllanthaceae), *Englerophytum natalense* T.D. Penn. (Sapotaceae) and mixed with, *e.g. Millettia grandis* Skeels (Leguminosae-Papilionoideae) and *Albizia suluensis* Gerstner (Leguminosae-Mimosoideae). Based on its distribution, *S. krooni* sp. nov. can be classified as a lowland species that is most probably endemic to the scattered Scarp forests as part of the "Tongaland-Pondoland regional mosaic" *sensu* White (1983).

Etymology. The species is named in memory for the South African Lepidopterist, the late Dr. Douglas Mervyn Kroon (born in 1940, died on 02nd August 2020), who not only collected the holotype, but helped I.L. significantly on research as well as publications on Kenyan Lepidoptera and Metarbelidae in the years 1999–2010.

Shimbania wichgrafi (Grünberg, 1910) comb. nov.

Figs 3e, 6b, 7e

Hollandella wichgrafi Grünberg, 1910: Deutsche Entomologische Zeitschrift, Heft III, 2. Mai 1910, 289–291: "Transvaal, Pretoria oder [or] Johannesburg, 1 ♂." Original combination.

Lepidarbela wichgrafi: von Dalla Torre & Strand, 1923, In: Strand, E. (Ed.) Lepidopterorum Catalogus, Vol. 4, Pars 28, 1. Mai 1923, page 6.
Lebedodes wichgrafi: Gaede 1929, In: Seitz, A. (Ed.) The Macrolepidoptera of the World, Vol. 14, page 502 + plate 78.

Material examined. Type, male, [Republic of South Africa], [Province Gauteng], "Pretoria oder [or] Johannesburg", no date, "F. Wichgraf S.G." [leg.] genitalia slide number 23/032009 I. Lehmann (ZMHU).

Re-description. ***Head*:** ventrally brownish-olive (without any chestnut colour), the rest is deep olive-buff, short scales with cream tips, glossy; eyes dark olive-brown without spots and surrounded by long hair-like scales of brownish-olive with a glint; a pair of rudimentary pits is present on lower fronto-clypeus, a pair of projections absent; pits behind labial palpi are narrow slits; antenna short, 0.37 length of forewing, bipectinate, branches long, 4.5× width of shaft, not scaled, all branches are widely separated at base, 2.0× width of branch; shaft covered with ivory-yellow scales dorsally; labial palpi long, slightly longer than half of eye-diameter, brownish-olive, at tip olive.

***Thorax*:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips; tegulae with long hair-like scales of dark chestnut with a light lilac glint. Metathorax with a crest of deep olive-buff scales mixed with scales of ivory-yellow and cream. Hind legs deep olive-buff with fine hair-like scales with light grey tips, on lower part of tarsus dark chestnut dorsally; with two pairs of tibial spurs of unequal width and length, upper pair broad, *ca.* 1.3 mm and 1.0 mm long, lower pair narrow, *ca.* 1.2 mm and 0.9 mm long. Forewing length 19.0 mm and wingspan is 42.5 mm. Forewing upperside largely light yellowish-olive on outer half of wing, mainly olive buff on inner half, with a light golden glint towards termen, costal margin distinctly coloured with light yellowish-olive and few dark olive striae; below first half of 1A+2A is a dark chestnut patch; forewing with very narrow and dark olive lines from costa to dorsum, radial veins distinctly marked with dark olive, CuA_2 narrowly dark olive; above the end of CuA_2 is a small patch of dark olive extending through the end of discal cell and towards costal margin; a dark olive "Y"-shaped subterminal patch, broadly oval, from R_3 to near end of CuA_1 and hence, with a short stalk; termen without lunules; cilia short, 1.0 mm, olive-buff with a glint. Underside of forewing is olive-buff with a golden glint. Hindwing upperside is pale olive-buff with a light golden glint; cilia as in forewing; underside as in forewing.

***Abdomen*:** Pale olive-buff with hair-like scales of ivory-yellow and cream with a light golden glint; abdominal tuft with hair-like scales of olive-buff, short, 1/5 length of abdomen. Genitalia with very long and narrow uncus, 90% of length of whole gnathos, narrow graben-like surface ventrally is present as well as a thickening in front of the uncus tip ventrally. Gnathos has gnathos arms that are large, one arm 40% the size of valva; upper part of the gnathos arm is a long band that is as long as 40% of basal width of valva, the lower part of the gnathal arm does not touch the other arm, it is of broad triangular shape with a pronounced thorn-like structure at tip and one short thorn-like structure behind it at middle, the base of the lower gnathal arm is 70% of the basal width of valva; the gnathal arms are connected ventrally by a narrow sclerotized band that is as broad as 25% of the transtilla and is widely bifurcated at the middle. The Gnathos arms end above the dorsal edge of the transtilla. The valva is elongated, broadly rectangular with a dorsal edge of 1.3× the length of uncus, ventral edge of valva not strongly bent inwards at half of ventral edge, with a tip that is broadly rectangular; sacculus not pronounced, narrow, weakly sclerotized, short, 30% of length of ventral edge of valva; juxta well developed, with two ear-shaped lobes and a short narrowly V-shaped emargination, tips of lobes rounded. Phallus large, as broad as 35% of basal width of valva and 20% longer than costal width of valva, bent upwards at tip distally, vesica without cornuti.

Diagnosis. *Shimbania wichgrafi* is a small species if compared to species of *Shimbania* occurring north of the Limpopo River. The genitalia of *S. wichgrafi* has a unique character combination, namely a long and narrow uncus with a thickening ventrally (in lateral view) and a broadly elongated rectangular valva with a broadly rectangular end. In contrast, the end of valva is broadly rounded in *S. durbanica*. The latter species has valvae with a dorsal edge of 2.0× the length of uncus, but in *S. wichgrafi* it is only 1.3× the length of uncus. Furthermore, *S. durbanica* can be separated by its very broad tegumen, representing the broadest among all species of *Shimbania* presented herein (it is broader than the length of the upper band-like structure of the gnathos, viewed ventrally).

Distribution. *Shimbania wichgrafi* is only known from areas in or around Pretoria (altitude 1.226–1.526 m), or Johannesburg (altitude 1.418–1.719 m), located *ca.* 40 km south of Pretoria and *ca.* 540 km west from the coastline of the Indian Ocean. The habitats in both areas belong largely to the "Central Bushveld" *sensu* Rutherford et al. (2006) (Savanna Biome) and "Mesic Highveld Grassland" *sensu* Mucina et al. (2006a) (Grassland Biome) including scattered small patches of "Northern Afrotemperate Forest" *sensu* Mucina and Geldenhuys (2006) on mountain kloofs and small ridges. In contrast to all other habitats of species of *Shimbania* these areas experience a frequent occurrence of frost. Generally, woody shrub and tree species increase with a higher surface rock cover and/or might increase due frequent cattle grazing. If trees are present, only small species occur in the two former biomes, *e.g. Acacia caffra* Willd. (Leguminosae-Mimosoideae), *A. nilotica* (L.) Willd. (Leguminosae-Mimosoideae), *A. tortilis* (Forssk.) Hayne (Leguminosae-Mimosoideae), *Protea caffra* Meisn. (Proteaceae), *Vangueria infausta* Burch. (Rubiaceae), while the forests comprise tall trees, *e.g. Olinia emarginata* Burtt Davy (Oliniaceae), *Podocarpus latifolius* R. Br. (Podocarpaceae) and *Rothmannia capensis* Thunb. (Rubiaceae). Many of such habitats that existed before the year 1910 are no longer present or are highly dissected today due to the two large cities. It is likely that the collecting site does no longer exist and that *S. wichgrafi* is potentially threatened.

Based on its distribution, *S. wichgrafi* can be classified as a submontane and montane species that occurs at the borderline of the "Zambezian regional centre of endemism" and the "Kalahari-Highveld regional transition zone" *sensu* White (1983).

Shimbania nigeriaensis sp. nov.

https://zoobank.org/8D8F5DF5-93CF-406D-82F6-9BF0DAEA1486

Fig. 3f

Material examined. Female, ***Holotype***, Nigeria, no locality, "18.4.60 1m, H9" [18. April 1960 altitude 1 m?], J. [Jorgen] Birket-Smith [leg.], genitalia slide number 06/122008 I. Lehmann (ZMUC).

Description. ***Head*:** deep olive-buff (without any chestnut colour), short scales with cream tips, slightly glossy; eyes dark olive without spots and surrounded by short hair-like scales of light brown and deep olive-buff with a weak glint; a pair of pits is absent on lower fronto-clypeus, a pair of well visible projections is present on fronto-clypeus; pits behind labial palpi are narrow oval-shaped holes; antenna short, 0.35 length of forewing, bipectinate, branches long, 3.0× width of shaft, not scaled, all branches are widely separated at base, 1.5× width of branch; shaft covered with cream scales dorsally; labial palpi long, slightly longer than half of eye-diameter, light brown.

***Thorax*:** Patagia deep olive-buff, forming a collar ring, scales with light grey tips; tegulae with long hair-like scales of sepia with a light lilac glint. Metathorax with a crest of pale olive-buff scales mixed with ivory-yellow scales, with a small patch of sepia at center. Hind legs deep olive-buff with fine hair-like scales, some with light grey tips, on lower part of tarsus sepia dorsally; only one pair of narrow tibial spurs of unequal length present, *ca.* 1.5 mm and 1.2 mm long. Forewing length 23.0 mm and wingspan is 50.5 mm. Forewing upperside deep olive-buff with a light golden glint towards termen, costal margin not distinctly marked; below first 2/3 of 1A+2A a sepia patch with a light lilac glint; forewing largely without any dark olive lines, veins not distinctly marked, except CuA_2 that is narrowly dark olive, but only weakly marked; a large, weak and dark olive "Y"-shaped subterminal patch, broadly oval-shaped, from R_3 to near end of CuA_2 with a short stalk; termen without lunules; cilia long, 1.2 mm, deep olive-buff with a glint. Underside of forewing is deep olive-buff with a golden glint. Hindwing upperside is pale olive-buff with a light golden glint and with few dark olive spots; cilia as in forewing; underside as in forewing.

***Abdomen*:** deep olive-buff mixed with cream, glossy; abdominal tuft olive-buff, medium long, 1/4 length of abdomen. Postabdominal structure: with a small, narrow papillae anales, not broader than base of posterior apophysis, with many short and long setae, lobes of papillae anales very small for such a large species, 20% of size of papillae anales with some long setae towards the tip of each lobe; segment 8 broadly rectangular with a broader dorsal edge, posterior margin with two rows of long setae (up to 85% as long as the dorsal part of segment 8), ventral part narrower, also with many long setae; an oblique row of long setae is absent on segment 8 (*cf. S. kerstinhempae* sp. nov.); attached to the ventral end of segment 8 is a narrow sclerotized band that is connected with the base of the anterior apophysis; anterior apophysis broad, short, 1.3× longer than posterior apophysis, broader at base and with short extension ventrally, straight, slightly bent upwards towards end; posterior apophysis broad, with the same width as anterior apophysis, with a broader tip, the extremely large sclerotized base of the posterior apophysis is 40% the size of the papillae anales in lateral view. Ductus bursae unknown, but at its base is a narrow slightly sclerotized plate ventrally; corpus bursae unknown.

Diagnosis. *Shimbania nigeriaensis* has a similar large wing size like most of the species presented herein from Kenya and Tanzania, but the postabdominal structure shares two characters with *S. durbanica* from the "Kwa-Zulu-Natal Coastal Belt" in the Republic of South Africa, namely two rows of very long setae along the posterior margin of segment 8 and very small lobes of the papillae anales that are only as large as 20% of the papillae anales. The postabdominal structure can be separated from all other congeners by a narrow dorsal gap of segment 8 that is as long as 80% of the dorsal edge. Such a gap is absent in *S. kerstinhempae* sp. nov. and *S. durbanica*. Another unique character of *S. nigeriaensis* sp. nov. is that the hindlegs have only one pair of tibial spurs instead of two pairs.

Distribution. If "1 m" represents the altitude of the collecting site in Nigeria it can be concluded that *Shimbania nigeriaensis* sp. nov. occurs locally along the coast of the Atlantic Ocean. A typical forest type along the coastline of the Atlantic Ocean from Sierra Leone to western Gabon is "Hygrophilous coastal evergreen Guineo-Congolian rain forest" *sensu* White (1983). This forest type is characterized by a very high diversity of woody legumes of the Caesalpinioideae, *e.g. Brachystegia cynometroides* Harms and has a very rich and distinctive endemic flora, *e.g. Sacoglottis gabonensis* (Baill.) Urb. (Humiriaceae). The average annual rainfall of more than 2000 mm, locally more than 3000 mm, is very high for the habitat. A common character with the habitat of *S. durbanica* is the absence of an entirely rain-free period (although the average rainfall is much lower with 989 mm, *cf.* above).

Based on its distribution, *S. nigeriaensis* sp. nov. can be classified as a lowland species that is most probably endemic to the "Hygrophilous coastal evergreen Guineo-Congolian rain forest".

Etymology. *Shimbania nigeriaensis* is named for the country Nigeria.

Morondavania gen. nov.

https://zoobank.org/1AA460B8-26A9-48F1-9311-C1F24A8E0DCB

Type species of genus. *Morondavania mineti* sp. nov. is designated as the type species.

Autapomorphies diagnosis. The genus is defined by the following combination of characters (*cf.* Lehmann 2019b, 102–105): Antennae bipectinate with very long branches, up to 7.0× longer than width of shaft, suddenly the branches become much shorter at *ca.* half of antennae and are up to 3.0× longer than width of shaft. Additionally, triangular-shaped forewings and triangular-shaped hindwings with straight termen, and hence, the termen of hindwing is not bent inwards as in *dubiefi* (Viette 1974; *cf. Saalmulleria* below). Wings of species of *Morondavania* are largely without a transparent appearance in male (in contrast to *dubiefi* where forewings and hindwings are largely transparent); a small thorn-like lower gnathal arm has 15–20% the size of valva, and is connected to the base of uncus by a long and broad weakly sclerotized band that has 40–50% the width of the dorsal length of the thorn-like structure; the phallus is at present the largest among Metarbelidae and with a unique shape, namely banana-like and strongly bent on whole length, with 50–60% as broad as basal width of valva on *ca.* 80% of its length, very narrow distally, and 30–40% longer than dorsal edge of valva.

Synapomorphies differential diagnosis shared with *Shimbania* gen. nov. from the African mainland (*cf. Shimbania* gen. nov. above).

Diagnostic characters in males of *Morondavania* gen. nov.

- In forewing, the basal point of the fork of R_1+R_2 is much closer to the anterior angle of median cell than the basal point of the fork of R_3+R_4. This is a potential synapomorphy with *dubiefi* (Viette 1974, *cf.* note to this species in *Saalmulleria*). This forewing venation is in contrast to species of *Saalmulleria* and *Eberhardfischeria* gen. nov. (*cf.* below).
- Cilia of forewing and hindwing extremely short with *ca.* 0.2 mm length and among the shortest in Metarbelidae from the Afrotropical and Oriental Region with a similar wingspan.
- The discocellular cell on the hindwing is similar in shape like a fish-tail, with the upper and lower tip in opposite position but with both tips not strongly pointed (in contrast *cf.* species of *Saalmulleria*).

Description. ***Head*** (Figs 4a, b, 5b, 7d, 11A, B, 12b, 16A): Rough-scaled; medium long hair-like scales of dark chestnut and brownish-olive with an olive glint on fronto-clypeus; eyes black; a pair of pits absent on lower fronto-clypeus, a pair of conical projections absent, slits or small oval holes behind labial palpi absent; labial palpi brownish-olive, short, less than half of eye- diameter, narrow, consisting of two segments; 2nd segment longest, elongated oval, *ca.* 6.0× longer than 1st (basal) segment that is very short, apical palpomere absent. Antennae bipectinate, basal half of antennae with narrow and very long branches up 7.0× longer than width of shaft, suddenly the branches become much shorter at *ca.* half of antennae and are up to 3.0× longer than width of shaft, branches are widely separated at base with 2.0× width of branch, dorsal and lateral sides of branches not scaled, but with many setae in pairs ventrally and laterally, dorsal and lateral sides of flagellum scaled brownish-olive.

***Thorax*:** Densely covered with hair-like scales of brownish-olive on patagia, often these scales have a light grey or pale olive tip, scales on patagia form no collar ring, scales on tegulae long hair-like, dark chestnut with a light lilac glint; scale crest on metathorax dark chestnut. Fore and mid legs brownish-olive with long dense hair-like scales with a light lilac glint. Epiphyses present, long, up to 2.1 mm, broad and flat. Hind legs brownish-olive, on lower part of tarsus without any darker patch, with two pairs of narrow tibial spurs, lower pair longer, up to 1.3 mm long, upper pair up to 1.0 mm long, all spurs with thorn-like tip. Wingspan is between 47.0 mm up to 49.5 mm. Forewing narrow triangular with a rounded apex, a strongly S-shaped dorsum with extremely short scales, upperside Dresden brown and brownish-olive towards termen with a light golden glint, scale pattern is weak, usually with very narrow lines of sepia from costa towards dorsum, between costa and CuA_1 a weak sepia band (sometimes absent), at base of M_2 and M_3 a small sepia patch, CuA_2 and other veins not distinctly marked, termen without lunules, a dark chestnut patch is present below base of 1A+2A, sometimes faded, sometimes up to 40% length of 1A+2A. Hindwing triangular, termen not bent inwards, largely with extremely short scales of Dresden brown with brownish-olive towards termen, some with a light lilac glint, sometimes with a patch at centre that has a slightly vitreous appearance but is still covered with short light brown scales with a light golden glint and is edged towards discal cell by a small sepia spot. Underside with extremely short scales of Dresden brown. Cilia extremely short with *ca.* 0.2 mm length, brownish-olive with a glint. Forewing venation (Fig. 5b) with 1A+2A only slightly forked at base, or fork absent; CuP absent, represented by a fold on 2/3 of its original length; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell; M_1 originating from distal margin of median cell and near its anterior angle; areole absent; R_1+R_2 originating from a medium long well visible stalk (the stalk has the length of 25–30% of R_3) and initiating from anterior angle of median cell; R_3+R_4+R_5 are very long stalked and originating from anterior angle of median cell; Sc more or less parallel to R_1. Hindwing venation with 3A present, 1A+2A present, with or without a small fork at base, CuP represented by a not sclerotized fold on 2/3 of its original length; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated; M_1 and Rs originating from anterior cell, broadly separated, with M_1 near ventral end of distal margin of anterior cell; in holotype with a short bar from near base of Rs to Sc+R_1 (Fig. 5b), a vein in discocellular cell on both fore- and hindwing is weak or absent. The discocellular cell on the hindwing is similar in shape like a fish-tail, but with the

Figure 4. a. *Morondavania mineti* sp. nov., holotype, male, Madagascar, Western Region, north of Morondava, Marofandilia Forest; **b.** *M. mineti* sp. nov., paratype, male, Madagascar, Western Region, north of Morondava, western part of Marofandilia Forest; **c.** *Eberhardfischeria husemanni* sp. nov., holotype, female, Madagascar, Western Region, Diégo Suarez (today Antsiraňana) or areas nearby; **d.** *E. husemanni* sp. nov., paratype, female, Madagascar, Western Region, Diégo Suarez (today Antsiraňana) or areas nearby; **e.** *Saalmulleria stumpffi* (Saalmüller, 1884), „Type“, female, Madagascar, Sambirano Region, Nosy Be Island, Lokobe; **f.** *S. analameranaensis* sp. nov., holotype, female, Madagascar, Western Region, Analamerana Forest, ca. 10 km to 40 km west of the Indian Ocean coastline; **g.** *S. ampandrandavaensis* sp. nov., holotype, female, Madagascar, Central Region, Ampandrandava, ca. 50 km northeast of Bekily.

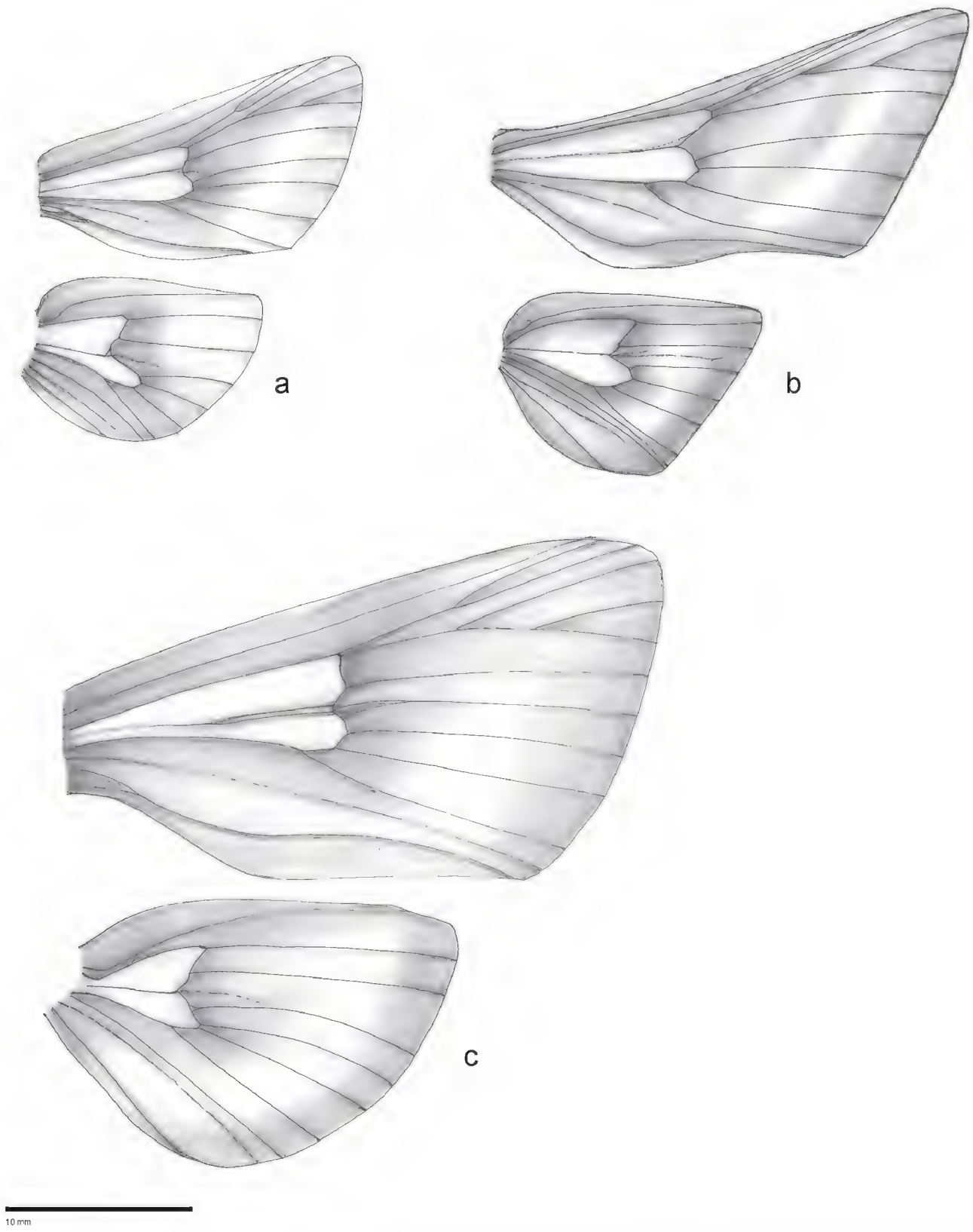


Figure 5. Wing venation: **a.** *Eberhardfischeria husemanni* sp. nov., paratype, female; **b.** *Morondavania mineti* sp. nov., holotype, male; **c.** *Saalmulleria stumpffi* (Saalmüller, 1884), "Type", female.

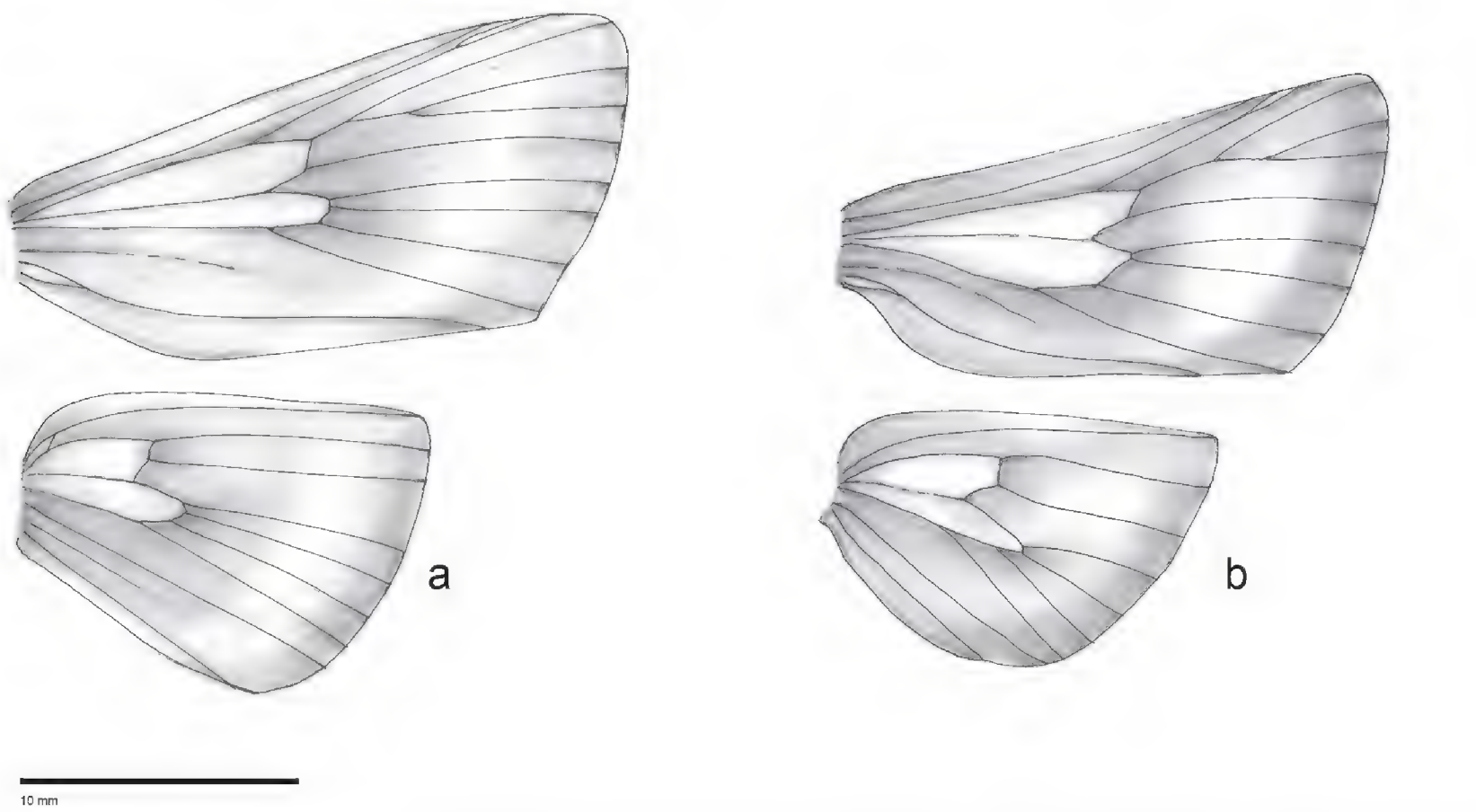


Figure 6. Wing venation: **a.** *Shimbania kerstinhempae* sp. nov., holotype, female; **b.** *S. wichgrafi* (Grünberg, 1910), "Type", male (all drawings by I.L.).

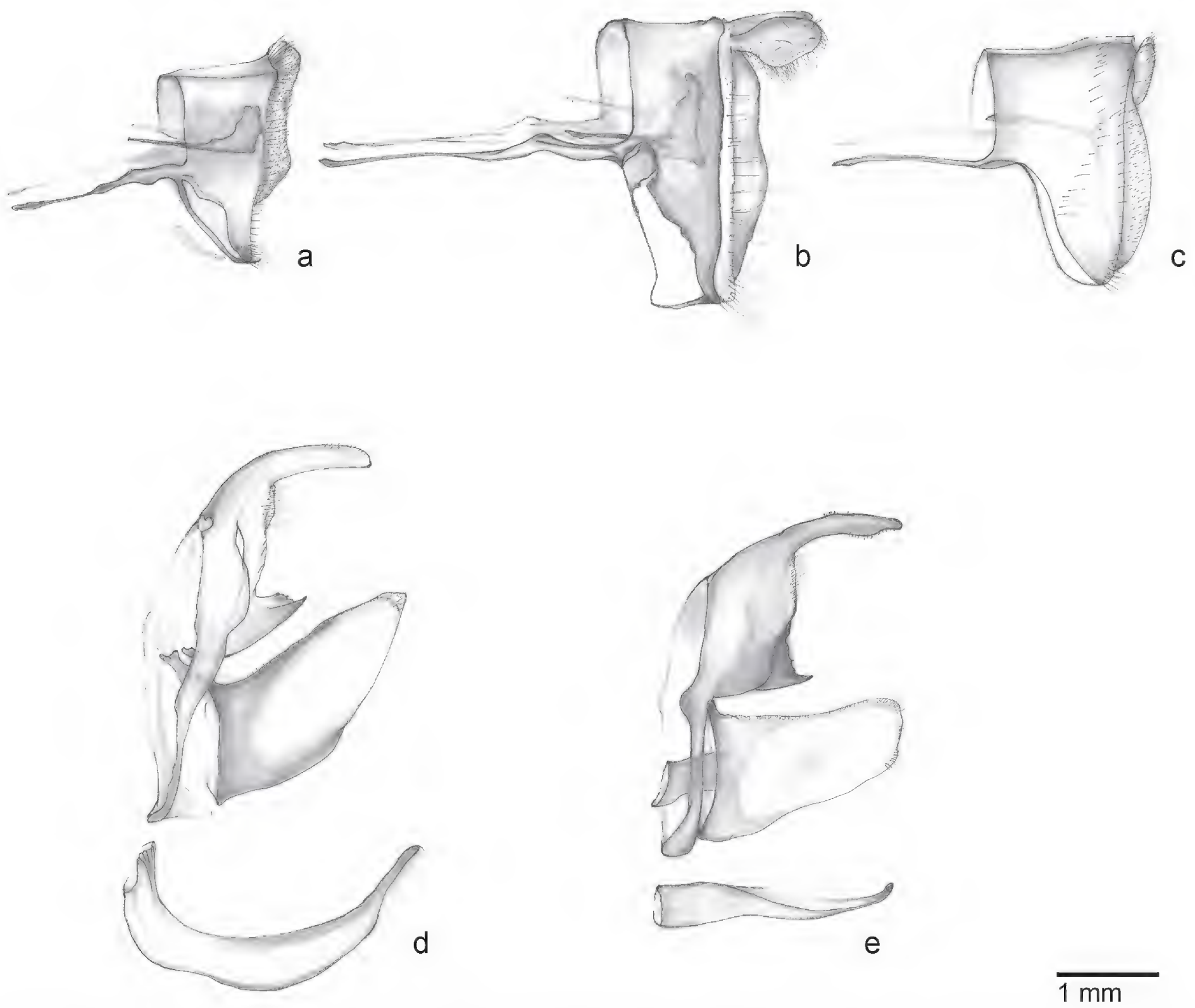


Figure 7. Female postabdominal structures and male genitalia in a not pressed condition: **a.** *Eberhardfischeria husemanni* sp. nov., paratype, female; **b.** *Saalmulleria stumpffi* (Saalmüller, 1884), "Type", female; **c.** *Shimbania kerstinhempae* sp. nov., holotype, female; **d.** *Morondavania mineti* sp. nov., paratype, male, with aedeagus below; **e.** *S. wichgrafi* (Grünberg, 1910), "Type", male, with aedeagus below (all drawings by I.L.).

upper and lower tip not strongly pointed. Fringe scales extremely short, 0.2 mm, brownish-olive with a glint. Retinaculum and frenulum absent.

***Abdomen*:** With dense hair-like scales of brownish-olive mixed with sepia and short abdominal tuft, *ca.* 20% of abdomen length. Male genitalia (Figs 11A, B, 12b) with tegumen and vinculum fused, forming a firm narrow ring, with tegumen *ca.* 2.0–3.0× broader than vinculum, the latter forms a narrow ring ventrally. Saccus present but strongly reduced with a broadly rounded or almost rectangular distal end. Uncus with heavy appearance, narrow elongated, well sclerotized, up to 30–40% of length of whole gnathos, flat dorsally, without a graben-like surface ventrally, not bifurcated at tip, with few tiny setae ventrally and dorsally, tip rounded. Basal edge of uncus well developed, slightly bent towards tip at center. Gnathos has gnathos arms that are medium large, one arm 25–30% the size of valva: upper part of the gnathos arm is a long, broad, weakly sclerotized band, as long as 70–80% of basal width of valva, that is attached to the basal part of uncus, the lower part of the gnathal arm is strongly sclerotized, of triangular shape with a pronounced thorn-like structure and with its ventral base in length *ca.* 50% of the basal width of valva, smaller thorns absent, strong horizontal folds are present; the triangular-shaped gnathos is hollow; the gnathal arms are connected ventrally by a sclerotized long, narrow band that is as broad as 25–30% of the transtilla. The Gnathos is short and ends well above the costa of valva. The valva is strongly bent upwards in lateral view (if not below glass), large, broad at base, elongated and almost triangular-shaped, tip narrowly rounded; sacculus broad, weakly sclerotized, 40–60% of length of ventral edge of valva, costal margin weakly sclerotized towards base of valva; largely the valva is thinly membranous with many soft setae on inner side, but no other structures are present. Juxta well developed, with two broadly almost rectangular lobes and a deep V-shaped emargination in between lobes, the tips of lobes are broadly rounded. Phallus simple, tube-like, at present the largest among Metarbelidae and with a unique shape,

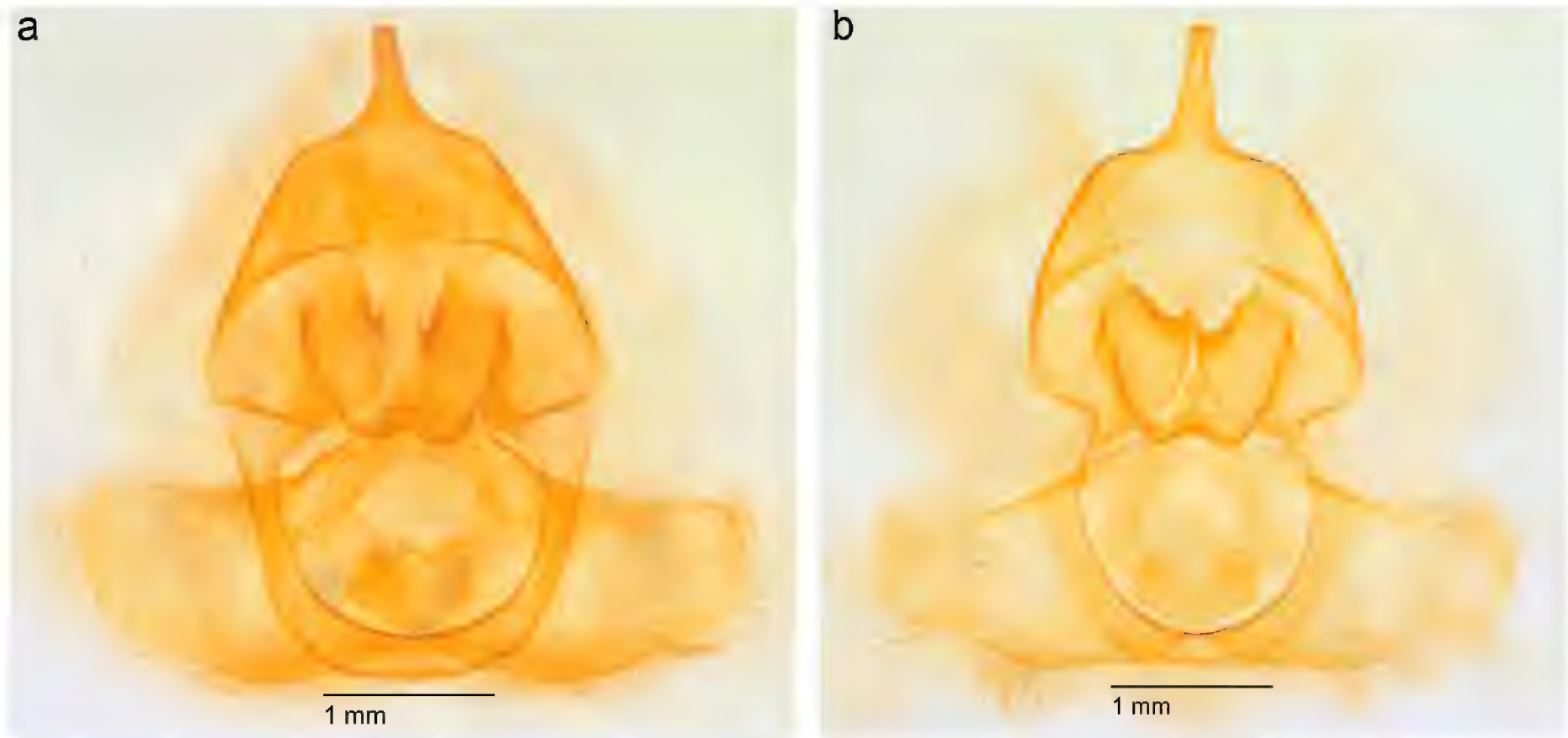


Figure 8. Male and female genitalia in a pressed condition below glass: **a.** *Shimbania baginerichardi* sp. nov., holotype, male, Kenya, Kwale County, Shimba Hills National Reserve; **b.** *S. tanaensis* sp. nov., paratype, male, Kenya, Mombasa County, Shimo la Tewa; **c.** *S. budaensis* sp. nov., holotype, male, Kenya, Kwale County, Buda Forest Reserve; **d.** *S. pwaniensis* sp. nov., holotype, male, Tanzania, Pwani Region, road from Dar es-Salaam to Chalinze, near the railway-crossing, ca. 2 km from the Ruvu River.

namely banana-like and strongly bent on whole length, with 50–60% as broad as basal width of valva on *ca.* 80% of its entire length, very narrow distally, and 30–40% longer than costal width of valva.

Female: unknown.

Species richness. Currently, this new genus is monotypic including one species new to science.

Distribution. The only species of *Morondavania* occurs on Madagascar in the "Western region" *sensu* Humbert (1955, 1965) (*cf.* distribution map in Lehmann 2019b, fig. 49). Species of this new genus are most probably restricted to the highly threatened primary dry deciduous forest and woodland patches within the "Madagascar Succulent Woodlands" ecoregion *sensu* Crowley (2004) as well as to the "Madagascar Dry Deciduous Forests" ecoregion *sensu* Crowley (2004). Due to the definitions of both ecoregions, the distribution range of species of the new genus extends within lowland areas below an altitude of 800 m of the "West Malagasy regional centre of endemism" *sensu* White (1983) and might include riverine forests. Both ecoregions are very rich in species of woody Leguminosae, comprising often locally endemic species, *e.g.* species of the genera *Albizia* Durazz. (Mimosoideae), *Bauhinia* L., *Cynometra* L., *Delonix* Raf. (Caesalpinioideae), *Dalbergia* L. and *Millettia* Wight & Arn. (Papilionoideae) with *Tamarindus indica* L. (Caesalpinioideae) in riverine forests (Labat and Moat 2003).

Biological traits. The biology of species of *Morondavania* is unknown at present**.** However, lowland tropical Metarbelidae species are strongly associated to habitats

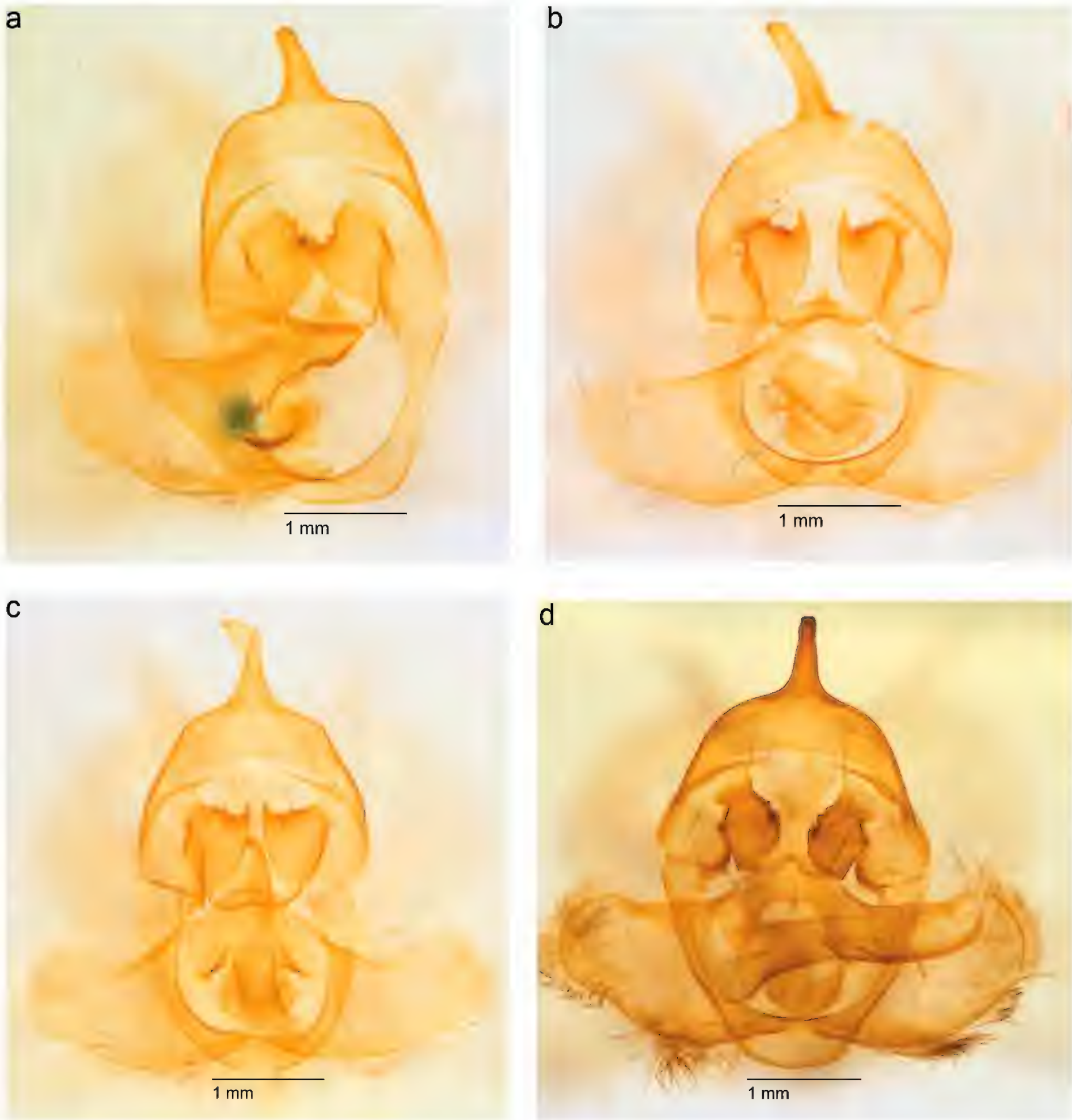


Figure 9. a. *Shimbania puguensis* sp. nov., paratype, male, Tanzania, Pwani Region, Kisarawe Forest; **b.** *S. kaguruensis* sp. nov., holotype, male, Tanzania, Morogoro Region, Kaguru Mountains; **c.** *S. mbarikaensis* sp. nov., holotype, male, Tanzania, Morogoro Region, Mbarika Mountains (also called Mbaraka Mountains), south of Mahenge Forest; **d.** *S. wanjakinuthiaae* sp. nov., holotype, male, Republic of South Africa, Province KwaZulu-Natal, ca. 5 km north of Hluhluwe, probably collected on Hluhluwe Farm.

with woody legumes (*cf. Shimbania* above; Lehmann 2008, 2019b) of the Papilionoideae, Mimosoideae and Caesalpiniodeae that are most diverse in deciduous vegetation with a marked dry season as well as in lowland humid evergreen forest on western, southwestern and extreme northern Madagascar including many species reflecting a strong affinity with species on the African mainland (Labat and Moat 2003).

Etymology. The genus is named after the Morondava River that is located *ca.* 19 km to the South of the type locality and might represent with its riverine forest patches another habitat for species of this new genus extending further inland (0–334 m and *ca.* 20°18'S–20°47'S and 44°14'E–45°15'E).

Morondavania mineti sp. nov.

https://zoobank.org/07A8B101-72E8-4C8B-81F7-BDC0990A6601

Figs 4a, b, 5b, 7d, 11A, B, 12b, 16A

Material examined. Male, ***Holotype***, Madagascar, "Ouest" [West], [Western Region], "N. [North] de Morondava", "forêt de Marofandilia" [Marofandilia Forest], "15. 4/9 — XII — 1969" [15. December?], P. Griveaud [leg.],

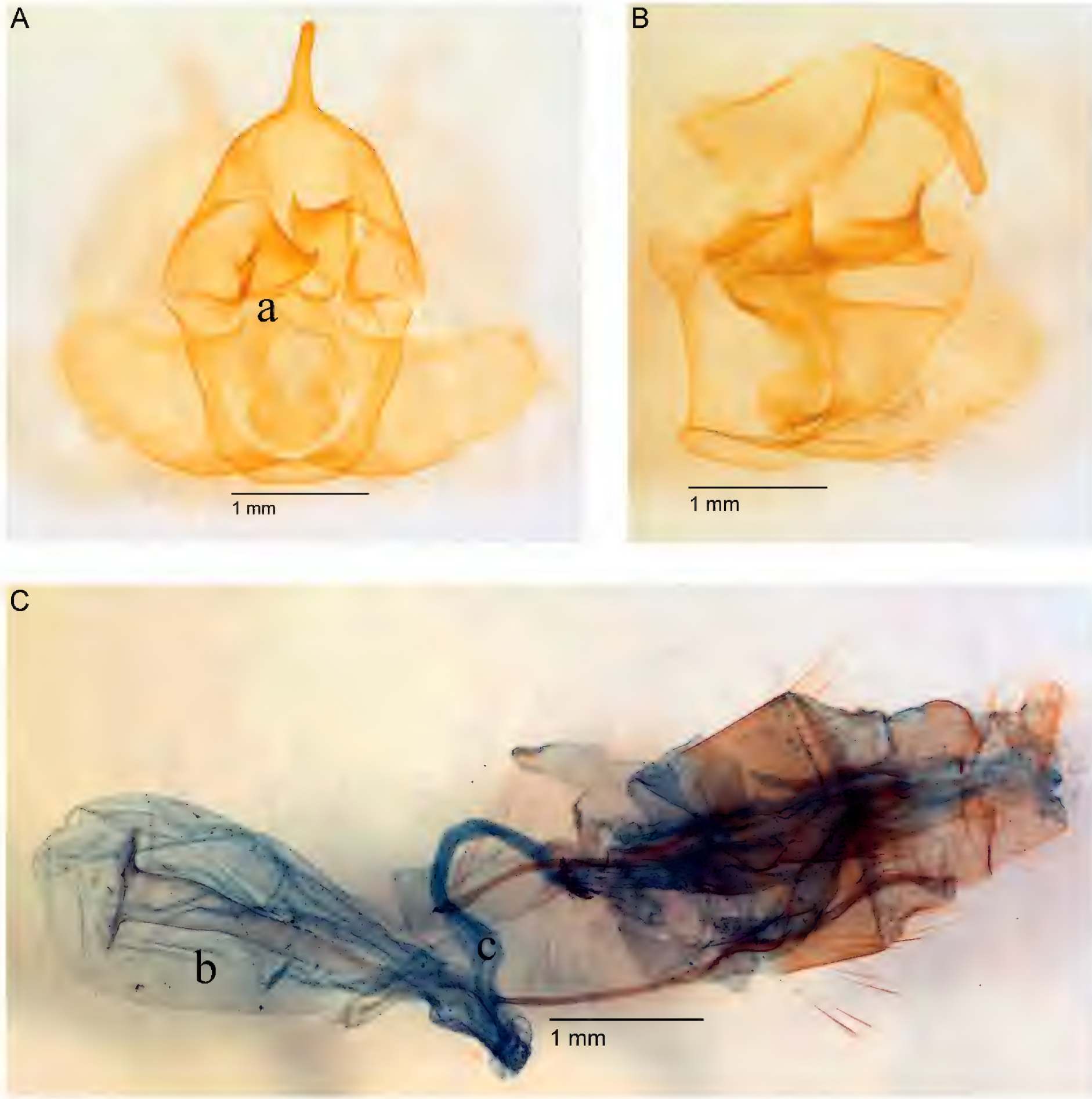
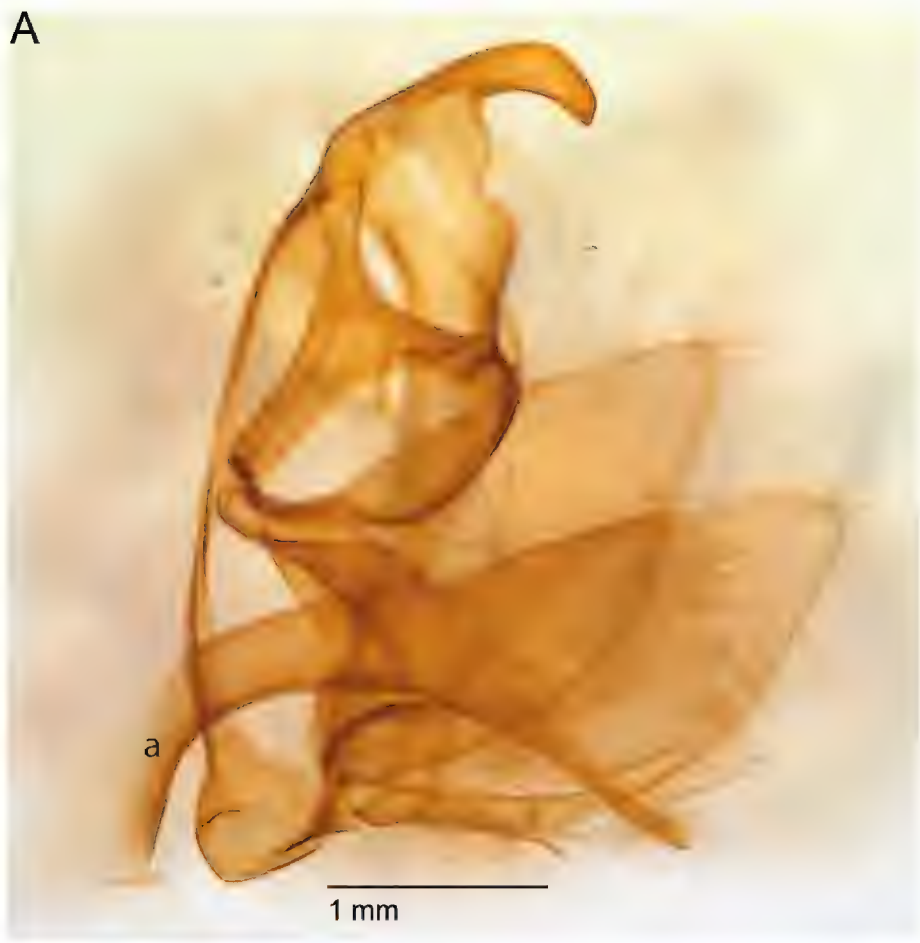


Figure 10. A. *Shimbania durbanica* (Hampson, 1910) comb. nov., male, Republic of South Africa, Province KwaZulu-Natal, Stanger, with a well visible broad transtilla (**a**); **B.** *S. krooni* sp. nov., holotype, male, Republic of South Africa, Province Eastern Cape, Port St. Johns; **C.** *S. durbanica* (Hampson, 1910) comb. nov., female, Republic of South Africa, Province KwaZulu-Natal, Durban, including one fungus (**b**) in the thinly membranous corpus bursae, the thinly membranous ductus bursae (**c**) is among the longest in Metarbelidae.

genitalia slide number 08/102009 I. Lehmann (MNHN) (*cf.* fig. 50 in Lehmann 2019b). ***Paratype***, male, same locality data, [additionally an altitude is presented] "15 m" [western part of the forest and west of Marofandilia town], December 1969, P. Griveaud [leg.], on a second label "no [number]: 0024 Institut Scientifique Madagascar", genitalia slide number B08/102009 I. Lehmann (MNHN).

Description. ***Holotype. Head*:** Rough-scaled; medium long hair-like scales of dark chestnut and brownish-olive with an olive glint on fronto-clypeus; labial palpi dark olive. Antennae bipectinate, basal half of antennae with narrow and very long branches 7.0× longer than width of shaft, suddenly the branches become much shorter at *ca.* half of antennae and are 2.5× longer than width of shaft, branches are widely separated at base with 2.0× width of branch, dorsal and lateral sides of flagellum scaled brownish-olive.

***Thorax*:** Densely covered with hair-like scales of brownish-olive on patagia, scales have a pale olive tip; scales on tegulae long hair-like, dark chestnut with a light lilac glint; scale crest on metathorax hair-like and dark chestnut. Fore and mid legs brownish-olive with long dense hair-like structures and a light lilac glint. Epiphyses long, 2.0 mm, broad and flat. Hind legs brownish-olive, on lower part of tarsus without any darker patch, with two pairs of narrow tibial spurs, lower pair 1.3 mm and 1.2 mm long, upper pair 1.0 mm and 0.9 mm long, all spurs with



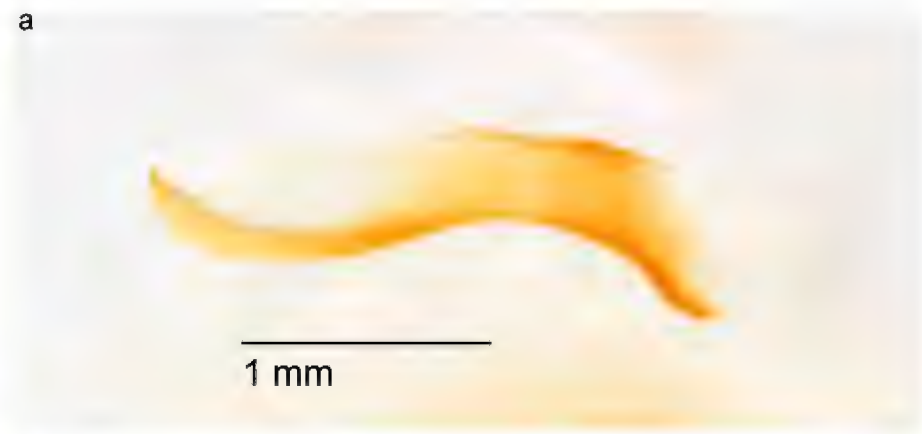


Figure 12. Aedeagus (phallus) of **a.** *Shimbania tanaensis* sp. nov., paratype, male, Kenya, Tana River County, Mchelelo Camp close to the Tana River; **b.** *Morondavania mineti* sp. nov., paratype, male, Madagascar, Western Region, north of Morondava, western part of Marofandilia Forest. The size of the aedeagus of the species of these sister-genera is among the largest in Metarbelidae.

Figure 11. A. *Morondavania mineti* sp. nov., holotype, male, with unique banana-like large phallus (a), Madagascar, Western Region, north of Morondava, Marofandilia Forest; **B.** *M. mineti* sp. nov., paratype, male, Madagascar, Western Region, north of Morondava, western part of Marofandilia Forest, with ventrally connected gnathal arms (b) and below, in horizontal position, with a broad, well sclerotized transtilla (c) that represents a synapomorphy shared with species of *Shimbania* gen. nov. The transtilla is rarely present among Metarbelidae and if so, it is narrow and often only thinly sclerotized.

thorn-like tip. Wingspan is 49.5 mm. Forewing narrow triangular with a rounded apex, a strongly S-shaped dorsum, extremely short scales on upperside Dresden brown and brownish-olive towards termen with a light golden glint, with very narrow lines of sepia from costa towards dorsum, at base of M_2 and M_3 a small sepia patch, a dark chestnut patch is present below base of 1A+2A. Hindwing triangular, termen not bent inwards, largely with extremely short scales of Dresden brown with brownish-olive towards termen, some with a light lilac glint, with a patch at centre that has a slightly vitreous appearance but is still covered with short light brown scales with a light golden glint. Underside with extremely short scales of Dresden brown. Cilia extremely short with *ca.* 0.2 mm length, brownish-olive with a glint. Forewing venation (Fig. 5b) with 1A+2A slightly forked at base; CuP absent; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell; M_1 originating from distal margin of median cell and near its anterior angle; areole absent; R_1+R_2 originating from a medium long stalk (the stalk has the length of 25% of R_3) and initiating from anterior angle of median cell; R_3+R_4+R_5 are very long stalked and originating from anterior angle of median cell; Sc more or less parallel to R_1. Hindwing venation with 3A present, 1A+2A present and without a small fork at base, CuP represented by a not sclerotized fold on 2/3 of its original length; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated; M_1 and Rs originating from anterior cell, broadly separated, with M_1 near ventral end of distal margin of anterior cell; a short bar from near base

of Rs to $Sc+R_1$ is present only in holotype (Fig. 5b), a vein in discocellular cell on forewing absent and in hindwing weak. The discocellular cell on the hindwing is similar in shape like a fish-tail, with tips not strongly pointed. Fringe scales extremely short with 0.2 mm, brownish-olive with a glint. Retinaculum and frenulum absent.

***Abdomen*:** With dense hair-like scales of brownish-olive mixed with sepia and short abdominal tuft, *ca.* 20% of abdomen length. Male genitalia (Figs 7d, 11A, B) with tegumen and vinculum fused, forming a firm narrow ring, with tegumen *ca.* 3.0× broader than vinculum, the latter forms a narrow ring ventrally. Saccus strongly reduced with a broadly rounded end. Uncus with heavy appearance, narrow elongated, well sclerotized with 30% of length of whole gnathos, flat dorsally, without a graben-like surface ventrally, not bifurcated at tip, with few tiny setae ventrally and dorsally, tip rounded. Basal edge of uncus well developed, slightly bent towards tip at center. Gnathos has gnathos arms that are medium large, one arm 25% the size of valva: upper part of the gnathos arm is a long, broad, weakly sclerotized band, as long as 70% of basal width of valva, that is attached to the basal part of uncus, the lower part of the gnathal arm is strongly sclerotized, of triangular shape with a pronounced thorn-like structure and with its ventral base in length *ca.* 50% of the basal width of valva, strong horizontal folds are present; the triangular-shaped gnathos is hollow; the gnathal arms are connected ventrally by a sclerotized long, narrow band that is as broad as 30% of the transtilla. The Gnathos is short and ends well above the costa of valva. The valva is strongly bent upwards in lateral view, large, broad at base, elongated and almost triangular-shaped, tip narrowly rounded; sacculus broad, weakly sclerotized, 60% of length of ventral edge of valva, costal margin weakly sclerotized towards base of valva; largely the valva is thinly membranous with many soft setae on inner side, without any structures. Juxta well developed, with two broadly almost rectangular lobes and a deep V-shaped emargination in between lobes. Phallus simple, tube-like, bent banana-like, with 50% as broad as basal width of valva on *ca.* 80% of its entire length, very narrow distally, and 30% longer than costal width of valva.

Female: unknown.

Distribution. *Morondavania mineti* sp. nov. is most probably restricted to the highly threatened primary dry deciduous lowland forest and woodland patches between the Tsiribihina and Morondava rivers (separated by *ca.* 60–90 km) including the Réserve Spéciale d' Andranomena (7.180 ha) adjacent to Marofandilia town located *ca.* 19 km northeast of Morondava (average rainfall 767–799 mm at Morondava, Sorg and Rohner 1996). In the latter reserve, at least 44% of the primary forest has been cut or is degraded since its establishment in 1955 (Sommer 2003). Primary forest and woodland patches between the two rivers mentioned above are located up to *ca.* 60 km inland from the coastline of the Indian Ocean (altitude 1–119 m) but have been substantially reduced due to human forest and woodland destruction until 1996 (at least 27.000 hectare were cut) with no primary forest left between Morondava up to 15 km to the North (Genini 1996), or primary forest structure is lost due to degradation and modification by fire or selective logging, *e.g.* the tree *Hazomalania voyronii* Jum. (Hernandiaceae) disappeared after 1988 from most forests around Morondava (Raonintsoa 1996). Within Marofandilia forest, located just north of the Andranomena River (*cf.* fig. 13.56 in Sommer 2003), the new species extends its range westwards to less than 6 km away from the Indian Ocean shoreline as indicated by the altitude of 15 m of the paratype collecting site and hence, occurs in dry forest on sandy soils. *Morondavania mineti* sp. nov. is almost certainly seriously threatened and endemic to lowland areas with a distinct dry season (May–October) of the "Madagascar Succulent Woodlands" ecoregion comprising vegetation that is very similar, and along the Tsiribihina River adjacent, to the "Madagascar Dry Deciduous Forests" ecoregion but includes more xerophytic species (Gautier and Goodman 2003). The dry deciduous forests in the habitat range of *M. mineti* sp. nov. and in the latter ecoregion are among the world's richest and most distinctive tropical dry forests with high local endemicity. The habitat of *M. mineti* sp. nov. is characterized by a high number of woody Leguminosae, *e.g. Albizia bernieri* E.Fourn., *Cordyla madagascariensis* R. Vig. (Mimosoideae), *Baudouinia fluggeiformis* Baill., *Cassia* L. spp., *Delonix* Raf. spp. as *D. boiviniana* (Baill.) Capuron (Caesalpinioideae) and *Dalbergia* L. spp., such as *Dalbergia lemurica* Bosser & R. Rabev., *D. pervillei* Vatke and *D. trichocarpa* Baker (Papilionoideae) (*cf.* Rakotonirina 1996; Labat and Moat 2003) and species of *Croton* L. (Euphorbiaceae) (Berry et al. 2017).

Biological traits. The biology of *M. mineti* sp. nov. is unknown, but most probably linked to woody legumes of Papilionoideae, Mimosoideae and Caesalpiniodeae. It would be interesting to know if larvae feed also inside of the seven species of *Adansonia* L. (Bombacaceae) that occur on Madagascar, *e.g. Adansonia grandidieri* Baill. occurs sympatrically with *A. rubrostipa* Jum. & H. Perrier and *A. za* Baill. in dry forests and near rivers around Morondava (Baum 2003); no Metarbelidae were recorded close to baobab trees in Kenya by I.L.

Etymology. The species is named for Professor Dr. Joël Minet (formerly Head of the Lepidoptera Section in the Département Origines et Evolution, MNHN, Paris) for his substantial support of studies on Metarbelidae until he retired in September 2021 as well as for his kind provision of unique Metarbelidae from Madagascar during the studies of I.L. at the MNHN in August 2009.

Eberhardfischeria gen. nov.

https://zoobank.org/D6303E2E-66E7-4D06-B30B-3C45740DE56D

Type species of genus. *Eberhardfischeria husemanni* sp. nov. is designated as the type species.

Autapomorphies diagnosis. The genus is defined by the following combination of characters in females: short, triangular-shaped forewings are only slightly longer than

rounded hindwings, both without any vitreous patches; and large lobes are in almost vertical position, as large as *ca.* 35% of papillae anales, with very long setae.

Differential diagnosis shared with *Saalmulleria* from Madagascar.

- The basal point of the well visible fork of R_1+R_2 has the same distance to the anterior angle of median cell as the basal point of the fork of R_3+R_4 (in contrast *cf.* species of *Morondavania* gen. nov.). Both basal points are at *ca.* 40–50% of the length of R_3.

Diagnostic characters in females of *Eberhardfischeria* gen. nov.

- The labial palpi are two-segmented, 2nd segment longest, slightly bent, oval, *ca.* 2.0× longer than 1st (basal) segment that is very short, rectangular and not broader, apical palpomere absent (in contrast *cf.* species of *Morondavania* gen. nov. and *Saalmulleria*).
- The lower part of the fronto-clypeus of the head has a well sclerotized and large plate-like structure with a strongly defined dorsal ridge (Fig. 16B, D).
- Strongly sclerotized and broad veins on both forewing and hindwing.
- Anterior apophysis has on the basal half a long, deep horizontal graben-like structure.

Description. Female *Head* (Figs 4c, d, 5a, 7a, 13a, b, 16B, D): Rough-scaled; long hair-like scales of light brownish-olive mixed with deep olive-buff scales on fronto-clypeus; eyes olive with black patches; a pair of tiny, rudimentary pits present on lower fronto-clypeus, a pair of conical projections absent, small oval pits behind labial palpi present; labial palpi deep olive-buff, half of eye-diameter, narrow, consisting of two segments; 2nd segment longest, slightly bent, oval, *ca.* 2.0× longer than 1st (basal) segment that is very short, rectangular and not broader, apical palpomere absent. Antennae bipectinate, narrow and long branches up to 3.5× longer than width of shaft, branches are widely separated at base with 1.5× width of branch, dorsal and lateral sides of branches not scaled, but with many setae in pairs ventrally and laterally, dorsal and lateral sides of flagellum scaled deep olive-buff mixed with brownish-olive.

***Thorax*:** Densely covered with hair-like scales of dark olive-buff with chestnut on upper half of scales on patagia, often these scales have a tiny light grey or pale olive tip, scales on patagia form a collar ring, scales on tegulae long hair-like, sepia and chestnut mixed with some scales of pale olive-buff with a light lilac glint; scale crest on metathorax pale olive-buff with a cream base, dark chestnut and sepia at center. Fore and mid legs deep olive-buff with long dense hair-like structures and a light golden glint. Epiphyses present, long, up to 2.0 mm, broad and flat. Hind legs in holotype and paratype unknown (missing). Wingspan is between 39.0 mm up to 42.5 mm. Forewing short, triangular with a rounded apex, upperside deep olive-buff and towards termen with a light golden glint, scale pattern is present, usually with a narrow, almost triangular band of dark olive-buff from costa towards end of CuA_1, the latter and CuA_2 are narrowly dark olive-buff, several very narrow bands and lines of dark olive-buff from costa to dorsum, termen without lunules, a dark chestnut patch is present below base of 1A+2A, up to 50% length of 1A+2A. Hindwing elongated, but rounded, termen not bent inwards, largely with short scales of deep olive-buff with a light golden glint, without any pattern. Underside with scales of deep olive-buff and cream with a light golden glint. Cilia very long with up to 1.5 mm length, deep olive-buff with a glint. Forewing venation (Fig. 5a) with 1A+2A deeply forked at base, fork is 25% the length of 1A+2A; CuP absent, but represented by a continuous fold that is not sclerotized; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell; M_1 originating from distal margin of median cell and not near its anterior angle; areole absent; R_1+R_2 originating from a long stalk (the stalk has the length of *ca.* 40–50% of R_3) and initiating from anterior angle of median cell; R_3+R_4+R_5 are long stalked and originating from anterior angle of median cell, the basal point of this stalk is exactly opposite of the basal point of the stalk of R_1+R_2; Sc more or less parallel to R_1. Hindwing venation with 3A present, 1A+2A present as a strong sclerotized fold, without a small fork at base, CuP represented by a sclerotized fold; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated; M_1 and Rs originating from anterior cell, broadly separated, with M_1 at center of distal margin of anterior cell (*cf.* different position of basal point of M_1 in hindwing of *Morondavania* gen. nov.); a short bar from Rs to Sc+R_1 is absent (Fig. 5a), a vein in discocellular cell on both fore- and hindwing is present and forked distally in forewing and sometimes with a tiny fork in hindwing. The discocellular cell on the hindwing is similar in shape like a fish-tail, but the upper and lower tip are not in opposite position, and both tips are not pointed. Fringe scales very long, up to 1.5 mm, deep olive-buff with a glint. Retinaculum and frenulum absent.

***Abdomen*:** With dense hair-like scales of deep olive-buff mixed with dark olive and short abdominal tuft, *ca.* 20% of abdomen length. Female postabdominal structure (Figs 7a, 13a, b) with large lobes of papillae anales, one lobe as large as 35% of papillae anales, lobes in almost vertical position; dorsal part elliptic in posterior view, covered with short and many long setae. Segment 8 represents a medium broad rectangular sclerotized band, more narrow ventrally, setose along its whole posterior margin with long setae, but without any setae on segment 8, with a narrow band attached ventrally extending to the base of anterior apophysis; anterior apophysis up to 2.3× as long as segment 8 dorsally, on their basal half of length 2× as broad as at tip, at middle knee-like shaped, in the basal half with a long, deep horizontal graben-like structure; posterior apophysis narrow with a three times

broader base on one-third of their entire length, up to 50% the length of anterior apophysis, with medium large sclerotized base up to 30% the size of papillae anales in lateral view; ductus bursae and corpus bursae are unknown.

Male: unknown.

Species richness. Currently, the new genus is monotypic including one species new to science.

Distribution. Species of *Eberhardfischeria* occur on northern Madagascar in the "Western region" and possibly in adjacent areas of the "Sambirano Region" and "Central Region" *sensu* Humbert (1955, 1965). Species of this new genus are most probably restricted to the highly threatened primary dry deciduous forest and woodland patches within the "Madagascar Dry Deciduous Forests" ecoregion *sensu* Crowley (2004) and adjacent to or including parts of the "Madagascar Humid Forests" and "Madagascar Subhumid Forests" ecoregion *sensu* Crowley (2004) up to an altitude of 1.475 m in the Parc National de la Montagne d'Ambre. Due to the definitions of both ecoregions, the distribution range of species of the new genus extend within lowland (below an altitude of 800 m) as well as submontane areas (below an altitude of 1.800 m, *cf.* Du Puy and Moat 2003) of the "West Malagasy regional centre of endemism" *sensu* White (1983). The "Sambirano Region" is a small exclave in the "East Malagasy regional centre of endemism" *sensu* White (1983) and a phytogeographically distinct unit with high levels of endemism in the flora particularly at lower elevations (Humbert 1955; Gautier and Goodman 2003). Noteworthy, woody species of Leguminosae are less diverse in East Malagasy primary lowland rain forests than in the Guineo-Congolian rain forests of the African mainland (White 1983); in contrast, the "Madagascar Dry Deciduous Forests" comprise highest diversities of woody Leguminosae on Madagascar (*cf. Morondavania* gen. nov.).

Biological traits. The biology of species of *Eberhardfischeria* is unknown at present**.** However, lowland tropical Metarbelidae species are strongly associated to habitats with a dominance of woody legumes (*cf. Shimbania* and *Morondavania* above; Lehmann 2008, 2019b) of the Papilionoideae, Mimosoideae and Caesalpiniodeae that are most diverse in deciduous vegetation with a marked dry season, but possibly also occurring locally in lowland humid evergreen forests on northern Madagascar. The latter forests experience a dry season of only two or four months and an average annual rainfall that exceeds 2000 mm per year. Subhumid forests are drier with an average annual rainfall of 1500 mm.

Etymology. The genus is named in honour of Professor Dr. Eberhard Fischer (University of Koblenz-Landau, Germany) for his contributions as the second supervisor on the Doctoral Dissertation of the first author in regard to botanical issues in context to the family Metarbelidae (*cf.* Lehmann 2019b). This genus from Madagascar is named also for him as Eberhard Fischer has done significant botanical research on Madagascar, *cf.* the chapters on the Scrophulariaceae and Balsaminaceae in the book "The Natural History of Madagascar" edited by Goodman and Benstead (2003).

***Eberhardfischeria husemanni* sp. nov.**

https://zoobank.org/B371828A-4A34-45F0-9CD5-927BA0177B62

Figs 4c, d, 5a, 7a, 13a, b, 16B, D

Material examined. Female, ***Holotype***, Madagascar, [Western Region], "Diégo Suarez" [Antsiranana], "6 Aug 17" [6th August 1917], G. Melou [leg.], a second label with number "403"; genitalia slide number 02/102007 I. Lehmann (BMNH). ***Paratype***, female, same locality data, "16 July, 17" [16th July 1917], G. Melou [leg.], genitalia slide number 03/112008 I. Lehmann (BMNH).

Description. *Holotype. Head*: Rough-scaled; medium long hair-like scales of olive-buff and dark olive-buff; labial palpi olive-buff. Antennae bipectinate, narrow and long branches 3.5× longer than width of shaft, branches are widely separated at base with 1.5× width of branch, dorsal and lateral sides of branches not scaled, but with many setae in pairs ventrally and laterally, dorsal and lateral sides of flagellum scaled deep olive-buff mixed with brownish-olive.

***Thorax*:** Densely covered with hair-like scales of dark olive-buff with chestnut on upper half of scales on patagia, scales with tiny light grey or pale olive tip, scales on patagia form a collar ring, scales on tegulae long hair-like, chestnut mixed with some scales of pale olive-buff with a light lilac glint; scale crest on metathorax pale olive-buff with a cream base, dark chestnut at centre. Fore and mid legs deep olive-buff with long dense hair-like structures and a light golden glint. Epiphyses 1.9 mm long, broad and flat. Wingspan is 39.0 mm. Forewing short, triangular with a rounded apex, upperside deep olive-buff and towards termen with a light golden glint, with a narrow, almost triangular band of dark olive-buff from costa towards end of CuA_1, the latter and CuA_2 are narrowly dark olive-buff, several very narrow bands and lines of dark olive-buff from costa to dorsum, a dark chestnut patch below base of 1A+2A, 40% length of 1A+2A. Hindwing elongated and rounded, largely with short scales of deep olive-buff with a light golden glint, without any pattern, a faded dark olive patch at center is present.

Forewing venation with 1A+2A deeply forked at base, fork is 25% the length of 1A+2A; CuP absent, but represented by a continuous fold that is not sclerotized; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell; M_1 originating from distal margin of median cell and not near its anterior angle; R_1+R_2 originating from a long stalk (the stalk has the length of *ca.* 50% of R_3) and initiating from anterior angle of median cell; R_3+R_4+R_5 are long stalked and originating from anterior angle of median cell, the basal point of this stalk is exactly opposite of the basal point of the stalk of R_1+R_2; Sc more or less parallel to R_1. Hindwing venation with 3A present, 1A+2A present as a strong sclerotized fold, without a small fork at base, CuP represented by a sclerotized fold; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated; M_1 and Rs originating

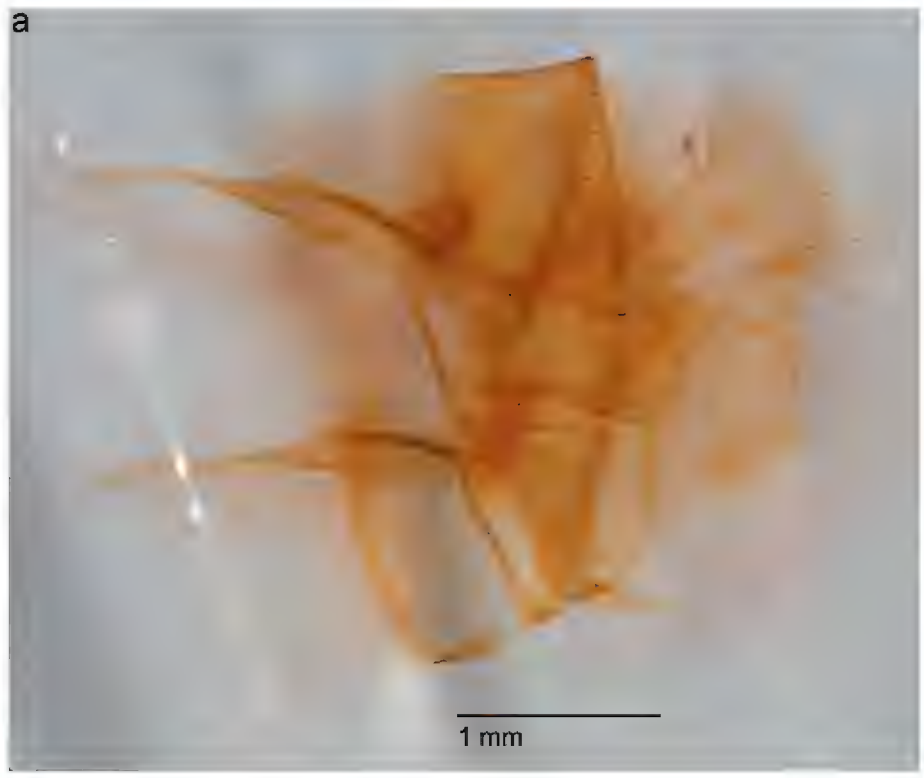


Figure 13. Female postabdominal structures of **a.** *Eberhardfischeria husemanni* sp. nov., holotype, female, Madagascar, Western Region, Diégo Suarez (today Antsirañana); **b.** *E. husemanni* sp. nov., paratype, female, Madagascar, Western Region, Diégo Suarez (today Antsirañana). The type locality is in or somewhere to the South of Diégo Suarez.

from anterior cell, broadly separated, with M_1 at center of distal margin of anterior cell; a bar from Rs to $Sc+R_1$ is absent, a vein in discocellular cell on both fore- and hindwing is present and forked distally in forewing. The discocellular cell on the hindwing is similar in shape like a fishtail, with upper and lower tip not in opposite position, and both tips not pointed. Fringe scales very long on forewing and hindwing, 1.5 mm, deep olive-buff with a glint.

***Abdomen*:** With dense hair-like scales of deep olive-buff mixed with dark olive and short abdominal tuft, *ca.* 20% of abdomen length. Female postabdominal structure with large lobes of papillae anales, one lobe as large as 35% of papillae anales, lobes in almost vertical position; dorsal part elliptic in posterior view, covered with short and many long setae. Segment 8 represents a medium broad rectangular sclerotized band, more narrow ventrally, setose along its whole posterior margin with long setae, with a narrow band attached ventrally extending to the base of anterior apophysis; anterior apophysis 2.3× as long as segment 8 dorsally, on their basal half of length 2× as broad as at tip, at middle knee-like shaped and in the basal half with a long, deep horizontal graben-like structure; posterior apophysis narrow with a three times broader base on one-third of their entire length, 50% the length of anterior apophysis, with medium large sclerotized base 30% the size of papillae anales in lateral view.

Distribution. Although "Diégo Suarez" [Antsirañana], located close to the northern tip of Madagascar at an altitude of 9–112 m, is mentioned as the collecting site on the label of the holotype and paratype, it is not sure that both females were collected in or near Antsirañana. In his thesis, Pierre Viette (1962) stated on pages 13, 36 and 52 about Gaston Melou, who collected Lepidoptera in the region of Diégo Suarez in the years 1916 and 1917, that Melou included areas such as Montagne d'Ambre (altitude up to 1.475 m) as well as Montagne des Français (altitude up to 393 m) in his collecting site termed "Diégo Suarez". The latter fact was confirmed by Dr. Albert Legrain (pers. comm. to I.L. in 2008). The forest of the Montagne des Français is a "Dry deciduous forest" (Pearce 2003) and hence, belongs to the highly threatened primary dry deciduous forest and woodland patches of the "Madagascar Dry Deciduous Forests" ecoregion *sensu* Crowley (2004) that covers large areas of the "Western Region". The Montagne d'Ambre was excluded from the "Western Region" by Gautier and Goodman (2003) as far as areas above 1.000 m are concerned. The latter belong to the montane areas of the "Central Region" *sensu* Humbert (1965) with extremely reduced forests of the "Moist montane forest type" or "Subhumid forest" occurring scattered across the central highlands of Madagascar (Gautier and Goodman 2003). Forests on Montagne d'Ambre belong largely to the "Madagascar Humid Forests" ecoregion *sensu* Crowley (2004), *cf.* also fig. 9 on plate V in Viette (1962), and are less dominated by woody legumes, but mainly by species of the genera, *e.g. Diospyros* L. (Ebenaceae), *Ocotea* Aubl. (Lauraceae), *Tambourissa* Sonn. (Monimiaceae); below 200 m altitude particularly by species of the family Palmae and of the genus *Dypsis* Noronha (Arecaceae); portions of "Madagascar Subhumid Forests" ecoregion *sensu* Crowley (2004) also occur and are characterized by a cool, dry season between July and September (*cf.* collecting dates) and a dominance of the Sarcolaenaceae and Euphorbiaceae, *e.g.* species of *Croton* L. as *C. jennyanus* Gris around Diégo Suarez. Hence, *Eberhardfischeria husemanni* sp. nov. might occur in dry deciduous forests and woodlands or in humid forests or in moist montane forest types of northern Madagascar. The new species is certainly under threat, maybe close to extinction, due to degradation of its habitats by fires and agriculture.

Biological traits. The biology of *E. husemanni* sp. nov. is unknown.

Etymology. The species is named for Dr. habil. Martin Husemann (Head of the Section Hymenoptera and Hemimetabolous Insects in the Leibniz-Institute for the Analysis of Biodiversity Change, Hamburg, Germany) for his substantial support of studies on Metarbelidae until present.

Saalmulleria Mabille, 1891

Type species of genus (*cf.* Lehmann 2019b). *Saalmulleria stumpffi* (Saalmüller, 1884).

Incorrect subsequent spelling (unavailable name, *cf.* ICZN 1999, Articles 33.3, 33.5): "*Saalmülleria*" in Gaede (1929) and in Viette (1974).

Note to the genus name. Mabille (1891) wrote "*Saalmulleria*", although "Saalmuelleria" should have been written, since diacritic marks cannot be put on scientific names (ICZN 1999, Article 27). Nevertheless, the original spelling mistake by Mabille has to be kept as "correct original spelling" (ICZN 1999, Article 32; also Fletcher and Nye 1995, p. 144).

Gaede (1929) transferred the genus "*Saalmülleria*" from the family Cossidae to the Metarbelidae. This was found to be correct by Lehmann (2019b) who included *Saalmulleria* in the Metarbelidae based on morphological characters and designated *Saalmulleria stumpffi* as type species of the genus.

Autapomorphies diagnosis. The genus is defined by the following combination of characters: very large and pear-shaped lobes of papillae anales are in horizontal position; the size of one lobe is at least 45% the size of the papillae anales and both lobes have very long setae mainly ventrally and a narrow, long, oblique graben-like structure without setae in its center.

Differential diagnosis shared with *Eberhardfischeria* gen. nov. from Madagascar.

- The basal point of the well visible fork of R_1+R_2 has the same distance to the anterior angle of median cell as the basal point of the fork of R_3+R_4 (in contrast *cf.* species of *Morondavania* gen. nov.). Both basal points are at *ca.* 30–50% of the length of R_3.

Diagnostic characters in females of *Saalmulleria*.

- The head is unusually small if compared to the large size of females, *e.g.* in the holotype of *S. stumpffi* only 3.0 mm in diameter, and is among the smallest heads in Metarbelidae.
- Labial palpi are three-segmented, all segments of almost equal length, basal segment broadest, also if compared to species of the other genera on Madagascar, namely *ca.* 1.5× broader than other segments, rectangular in shape (*cf.* labial palpi of species of *Morondavania* gen. nov. and *Eberhardfischeria* gen. nov.).
- The lower part of the fronto-clypeus of the head has no plate-like structure.
- The discocellular cell of the hindwing has a shape like a fish-tail with the upper and lower tip in opposite position, and with the upper tip strongly pointed and bent; in contrast, *cf. Morondavania* gen. nov. and *Eberhardfischeria* gen. nov.
- The hindwing has usually three anal veins present including a strongly sclerotized, broad 1A+2A (a very rare character in Metarbelidae).
- The forewings and hindwings are not largely transparent (largely means herein that at least 50% of the forewing and at least 50% of hindwing are transparent).

A note to Gen. Nov. *dubiefi* (Viette, 1974). According to the autapomorphies and diagnostic characters of *Saalmulleria* presented above, the species "*Saalmülleria dubiefi*" (Viette, 1974; published with an incorrect subsequent spelling of the genus name) is excluded here from the genus *Saalmulleria*. There are several reasons for this step that are based on the detailed picture of the male holotype as well as a drawing of its venation done by Professor Dr. Joël Minet and presented to I.L. at the MNHN (Paris) in 2009: first, the only male of *dubiefi* (collected in Ambanja, 02nd August 1970 by M. P. Dubief, located at an altitude of 12–50 m in the Sambirano Region and "Madagascar Subhumid Forests" ecoregion) has triangular-shaped wings, largely transparent forewings and largely transparent hindwings as well as a termen that is bent inwards on the hindwings. This is a unique combination of characters among Metarbelidae. Largely transparent wings are extremely rare among Metarbelidae and only known from two species in the monotypic genera *Janegoodallia* Lehmann, 2014 and *Dukearbela* Mey, 2018, both occurring on the African mainland. Second, the wing venation of *dubiefi* is similar to the species of *Morondavania* gen. nov., comprising one possible synapomorphy in the forewing venation with the latter genus (*cf.* diagnostic characters of *Morondavania* gen. nov.). Third, based on the comprehensive morphological study of the Metarbelidae by I.L. it is unlikely that *M. mineti* sp. nov. and *dubiefi* are congeneric. However, as long as the male genitalia of *dubiefi* has not been studied (it is not allowed to dissect the holotype due to the regulations in the MNHN, J. Minet pers. comm. to I.L. in 2009) it should be treated as a species that belongs to an undescribed genus of Metarbelidae. Due to the latter fact, *dubiefi* is not presented herein with any detailed description.

Description of *Saalmulleria*. Female *Head* (Figs 4e–g, 5c, 7b, 14a, b, 15, 16C, E, F): Unusually small; rough-scaled; long hair-like scales of light brownish-olive mixed with deep olive-buff and sepia scales on fronto-clypeus, some with a light lilac and golden glint, or without glint; eyes olive or brownish-olive with small black patches or sepia or dark olive spots; a pair of pits is present, rudimentary or entirely absent (*cf. S. stumpffi*) on lower fronto-clypeus, a pair of conical projections always absent, pits behind labial palpi absent; lower fronto-clypeus is broad, as broad as half of eye-diameter (viewed anteriorly) and smooth, without any structures; labial palpi

dark olive-buff, very short, less than half of eye- diameter, narrow, consisting of three segments, all segments are of almost equal length, 1st (basal) segment is very broad, at least 1.5× broader than central segment, rectangular. Antennae bipectinate, narrow and long branches up to 4.0× longer than width of shaft, branches are widely separated at base with up to 2.0× width of branch, dorsal and lateral sides of branches not scaled, but with many setae in pairs ventrally and laterally, dorsal and lateral sides of flagellum scaled deep olive-buff mixed with brownish-olive.

***Thorax*:** Densely covered with hair-like scales and broader scales of olive-brown with dark olive tips on patagia and on tegulae, some scales on tegulae with a light lilac glint; scale crest on metathorax is pronounced with long olive-brown hair-like scales with a slightly broader tip of dark olive. Fore and mid legs olive-brown, dorsally sepia, with long dense hair-like structures and a light lilac glint. Epiphyses present, up to 2.5 mm long, medium broad and flat. Hind legs with two pairs of tibial spurs, upper pair more narrow and longer, up to 2.1 mm long, spurs in lower pair broader, up to 1.4 mm long. Wingspan is the longest among Metarbelidae in a worldwide context (*cf. S. stumpffi*), namely between 55.0 mm up to 70.5 mm. Forewing large, broad with a rounded apex, upperside without any geometric design, deep olive-buff or greyish-olive and towards termen with a light golden glint, a simple scale pattern is present, usually with a lunule-like sepia patch (sometimes absent or reduced) at center of forewing from base of M_2 to base of CuA_1, the patch is edged inwards by a small transparent spot (*cf. S. stumpffi*), sometimes this spot is absent, various dark olive terminal, sub-terminal and post-medial patches and bands, sometimes broadly V-shaped or slightly Y-shaped, from near costa to CuA_2, termen without lunules or with weak dark olive lunules, a dark chestnut or sepia patch is present below base of 1A+2A, up to 30% length of 1A+2A. Hindwing rounded with a pointed apex, termen not bent inwards, largely with short scales of deep olive-buff or greyish-olive, with a light golden glint, with a sepia patch (sometimes absent or reduced) at center of hindwing from base of M_2 to base of CuA_1, but the patch is not edged inwards by a small transparent spot as in forewing. Underside with scales of deep olive-buff with a light golden glint. Cilia short with up to 1.1 mm length, deep olive-buff with a glint. Forewing venation (Fig. 5c) with strongly sclerotized and broad veins, 1A+2A deeply forked at base, fork is up to 25% the length of 1A+2A; CuP absent, sometimes represented by a continuous weak fold that is not sclerotized, or CuP is slightly sclerotized on first 2/3 of its length and disappears on last third completely; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separated and initiating from apical angle of posterior cell; M_1 originating from distal margin of median cell and is broadly separated from its anterior angle; areole absent; R_1+R_2 originating from a long stalk (the stalk has the length of *ca.* 30–40% of R_3) and initiating from near anterior angle of median cell; R_3+R_4+R_5 are long stalked and originating from anterior angle of median cell, the basal point of this stalk is exactly opposite of the basal point of the stalk of R_1+R_2; Sc more or less parallel to R_1. Hindwing venation with 3A present, 1A+2A present or represented by a sclerotized fold, with a small fork at base, CuP present; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated, sometimes M_2 has a tiny fork at base (*cf. S. stumpffi*); M_1 and Rs originating from anterior cell, broadly separated, with M_1 at center of distal margin of anterior cell (*cf.* different position of basal point of M_1 in hindwing of *Morondavania* gen. nov.); a short bar from Rs to Sc+R_1 is absent or weak (Fig. 5c), a strongly sclerotized vein in discocellular cell on both fore- and hindwing is present and sometimes long forked distally in forewing (a very rare character in Metarbelidae, *cf. S. stumpffi*). The discocellular cell on forewing and hindwing is small, only up to 20% of wing size. The discocellular cell on the hindwing is similar in shape like a fish-tail, with the upper and lower tip in opposite position, and the upper tip is strongly pointed. Fringe scales short if compared to the large wing size, up to 2.0 mm, deep olive-buff with a glint. Retinaculum and frenulum absent.

***Abdomen*:** Very long, up to 32.0 mm (*S. stumpffi*) with hair-like scales of deep olive-buff or greyish-olive with a strong light golden glint, mixed with dark olive, upper part of abdomen sepia or dark chestnut, end of abdomen sometimes sepia, abdominal tuft short, up to 5.0 mm long, or *ca.* 15% of abdomen length, sepia or dark chestnut.

Female postabdominal structure and genitalia with very large, pear-shaped lobes of papillae anales in horizontal position, one lobe at least 45% the size of papillae anales (*cf.* species of *Eberhardfischeria* gen. nov. with much smaller lobes), lobes ventrally with long setae and few long setae along the edge, each lobe with a long oblique graben-like structure that has no setae at center; papillae anales covered with many short and many long setae. Segment 8 represents a medium broad rectangular sclerotized band, more narrow ventrally, setose along its whole posterior margin with long setae, or without any setae on dorsal part of posterior margin, and without any setae on segment 8, with a very narrow band attached ventrally extending to the base of anterior apophysis, where the band is weakly attached and has a very broad rectangular-shaped base that fits like a segment into segment 8 (Fig. 7b, only visible in fresh preparations); anterior apophysis slightly or strongly bent downwards, up to 3.0× as long as segment 8 dorsally, on their basal half of length up to 2× as broad as at tip, within the first 30% of their length strongly knee-like shaped (*cf. Eberhardfischeria* with anterior apophysis knee-like shaped at middle), on almost the whole length with a deep horizontal graben-like structure; posterior apophysis narrow with four times broader base, up to 60% the length of anterior apophysis, with large sclerotized base up to 40% the size of papillae anales in lateral view, posterior apophysis longer or equal in length of dorsal part of segment 8; ductus bursae and corpus bursae are both membranous (*cf. S. ampandrandavaensis* sp. nov.), or ductus bursae is thickly membranous (*cf. S. analameranaensis*

sp. nov.), ductus bursae broad, short (up to 50% the length of corpus bursae) with or without a small thickly membranous, pear-shaped structure at base, the base is not broader and not sclerotized, corpus bursae very large, up to 4× as large as segment 8 in lateral view, membranous, not sclerotized at any part, without any structures, elongated, oval (*cf. S. ampandrandavaensis* sp. nov.).

Male: unknown.

Species richness. Currently, *Saalmulleria* comprises four species, including three species new to science of which two new species are described here. One species that is represented by a female (deposited in MNHN) was not studied and is treated here as undescribed — it is labelled as follows: "Madagascar Est [East] 42 km N. de Sambava [North of Sambava / Eastern Region] forêt d' Analabe 50 m [Analabe forest altitude 50 m / "Madagascar Humid Forests" ecoregion], 15/20-XI-1958 P. Griveaud, A. Peyrieras et P. Viette" [leg.].

Distribution. Species of *Saalmulleria* occur in the "West Malagasy regional centre of endemism" as well as "East Malagasy regional centre of endemism" *sensu* White (1983) and might be still present on the whole island of Madagascar if natural woody habitats are still available (*cf.* distribution map in Lehmann 2019b, fig. 47). In northern Madagascar, the distribution range covers the "Sambirano Region", "Western Region" as well as "Eastern Region" *sensu* Humbert (1955, 1965), extending from the Réserve Naturelle de Lokobe off the northwestern coast of Madagascar towards the Réserve Naturelle de la Analamerana in the Northeast of the main island and from there southeastwards to north of Sambava close to the eastern coast with the Indian Ocean (*cf.* note above). Within this area, species of *Saalmulleria* are known from different lowland forest types within the "Madagascar Dry Deciduous Forests" ecoregion, the "Madagascar Subhumid Forests" ecoregion and the "Madagascar Humid Forests" ecoregion. The altitude range is 5–419 m and comprises forests with an average annual rainfall of 1500 mm to more than 2000 mm (*cf. Eberhardfischeria* gen. nov. with a similar habitat range). In southern Madagascar, species of *Saalmulleria* occur in the submontane and subarid area of Ampandrandava in the "Madagascar Succulent Woodlands" ecoregion *sensu* Crowley (2004) and close to the southwestern limit of the central highlands, "Central Region", with an average annual rainfall of only 575–1330 mm.

Biological traits. The biology of species of *Saalmulleria* is unknown at present**.** However, lowland tropical Metarbelidae species are strongly associated to habitats with a dominance of woody legumes (Lehmann 2008, 2019b). Leguminosae on Madagascar are in general diverse in the northern, western and southern parts, with particular high densities in areas with a marked dry season and deciduous vegetation (Labat and Moat 2003). Two species of *Saalmulleria* presented here from northern and southern Madagascar are linked to the latter areas.

Key to the species of *Saalmulleria*

The key is based primarily on characters of the genitalia; hence, it cannot serve as a field identification key. For all species, only one female specimen is available, so identifications obtained from this key should be cross-checked carefully with the description, distribution, and figures presented in this paper.

1	Female 2
2(1)	Lobes of papillae anales in horizontal position, very large, one lobe is at least 45% the size of papillae anales 3
3(2)	Lobes of papillae anales not longer than segment 8 dorsally 4
–	Lobes of papillae anales much longer than segment 8 dorsally 5
4(3)	Anterior apophyses strongly bent downwards, 2.0× longer than dorsal width of segment 8, large extension of ductus bursae near its base ..... *S. analameranaensis* sp. nov.
5(3)	Lobes of papillae anales largest in Metarbelidae, one lobe is 50% the size of papillae anales, anterior apophyses 3.0× longer than dorsal width of segment 8, posterior apophyses long, 50% length of anterior apophyses ..... *S. stumpffi*
–	Not as above, one lobe is 45% the size of papillae anales, posterior apophyses short with 30% length of anterior apophyses ..... *S. ampandrandavaensis* sp. nov.

Saalmulleria stumpffi (Saalmüller, 1884)

Figs 4e, 5c, 7b, 14a

Cossus stumpffi Saalmüller, 1884: In: Saalmüller, M. (Ed.) Lepidopteren von Madagaskar. Neue und wenig bekannte Arten. Zumeist aus der Sammlung der Senckenberg'schen naturforschenden Gesellschaft zu Frankfurt am Main. Erste Abtheilung: Rhopalocera. Heterocera. Shinges et Bombyces. Cossidae: 210–211. Original combination.

Material examined. Female, "Type", "Madag." [Madagascar], "Loucoubé" [Lokobe, Nosy Be Island, Sambirano Region], "Stumpff 82" [1882], "X-II-82" [on another tiny label, 10th February 1882] Stumpff [Anton Stumpff from "Nossi-Bé" leg.; one specimen only, *cf.* Saalmüller 1884, pp. 210–211]; genitalia slide number 20/122008 I. Lehmann (SNMF).

Re-description. Female *Head*: Unusually small, 3.0 mm in diameter; rough-scaled; long hair-like scales of light brownish-olive mixed with sepia scales on fronto-clypeus, some with a light lilac and golden glint; eyes brownish-olive with small dark olive spots; a pair of pits is entirely absent on lower fronto-clypeus, a pair of

conical projections absent, pits behind labial palpi absent; lower fronto-clypeus is broad, as broad as half of eye-diameter (viewed anteriorly) and smooth, without any structures; labial palpi dark olive-buff, very short, less than half of eye diameter, narrow, consisting of three segments, all segments are of almost equal length, 1st (basal) segment is very broad, at least 1.5× broader than central segment, rectangular. Antennae bipectinate, narrow and long branches 3.5× longer than width of shaft, branches are widely separated at base with 2.0× width of branch, dorsal and lateral sides of branches not scaled, but with many setae in pairs ventrally and laterally, dorsal and lateral sides of flagellum scaled deep olive-buff mixed with brownish-olive.

***Thorax*:** Densely covered with hair-like scales and broader scales of olive-brown with dark olive or sepia tips on patagia and on tegulae, sepia scales on tegulae with a light lilac glint; scale crest on metathorax is pronounced with long olive-brown hair-like scales with a slightly broader sepia tip. Fore and mid legs olive-brown, dorsally sepia, with long dense hair-like structures and a light lilac glint. Epiphyses present, 2.5 mm long, medium broad and flat. Hind legs with two pairs of tibial spurs, upper pair narrower and longer, up to 2.1 mm long, spurs in lower pair broader, up to 1.4 mm long, all spurs with a claw-like tip. Wingspan is 70.5 mm. Forewing length is 32.0 mm (as long as abdomen), large, broad with a rounded apex, upperside without any geometric design, deep olive-buff and towards termen with a light golden glint, a simple scale pattern is present, with a lunule-like sepia patch at center of forewing from base of M_2 to base of CuA_1, the patch is edged inwards by a small transparent spot, various terminal, sub-terminal and post-medial patches and bands of Saccardo's umber, with a prominent broad V-shaped band of Saccardo's umber from apex and costa to near end of CuA_2, the latter vein is not marked in a different colour, termen with weak triangular dark olive lunules, a sepia patch is present below 30% of length of 1A+2A. Hindwing rounded but with a prominent pointed apex, termen not bent inwards, largely with short scales of deep olive-buff with a light golden glint, with a sepia patch at center of hindwing from base of M_2 to base of CuA_1, but the patch is not edged inwards by a small transparent spot as in forewing. Underside with scales of deep olive-buff with a light golden glint. Cilia very short for such a large species, 1.1 mm long, deep olive-buff with a glint. Forewing venation with strongly sclerotized and broad veins, 1A+2A deeply forked at base, fork is 25% the length of 1A+2A; CuP absent, but represented by a fold, slightly sclerotized on first 2/3 of its length; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separated and initiating from apical angle of posterior cell; M_1 originating from distal margin of median cell and is broadly separated from its anterior angle; areole absent; R_1+R_2 originating from a long stalk (the stalk has the length of *ca.* 40% of R_3) and initiating from near anterior angle of median cell; R_3+R_4+R_5 are long stalked and originating from anterior angle of median cell, the basal point of this stalk is exactly opposite of the basal point of the stalk of R_1+R_2; Sc more or less parallel to R_1. Hindwing venation with three anal veins, 3A present, 1A+2A present with a well sclerotized fork at base, CuP present and well sclerotized; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated, M_2 has a tiny fork at base; M_1 and Rs originating from anterior cell, broadly separated, with M_1 at center of distal margin of anterior cell; a short bar from Rs to Sc+R_1 is weak, a strongly sclerotized vein in discocellular cell on both fore- and hindwing is present and long forked distally in forewing (a very rare character in Metarbelidae). The discocellular cell on forewing and hindwing is small, only *ca.* 15% of wing size. The discocellular cell on the hindwing is similar in shape like a fish-tail, with the upper and lower tip in opposite position, and the upper tip is strongly pointed and bent. Fringe scales short if compared to the large hindwing size, 2.0 mm long, deep olive-buff with a glint. Retinaculum and frenulum absent.

***Abdomen*:** Very long with 32.0 mm in length and very broad at center with 9.0 mm, with hair-like scales of deep olive-buff, some with chestnut tips, and a strong light golden glint, upper part of abdomen broadly sepia, end of abdomen broadly sepia, abdominal tuft short with 5.0 mm length, sepia.

Female postabdominal structure with very large, pear-shaped lobes of papillae anales in horizontal position, one lobe 50% the size of papillae anales, lobes ventrally with long setae and few long setae along the edge, each lobe with a long and deep oblique graben-like structure that has no setae at center; papillae anales covered with many short and many long setae. Segment 8 represents a medium broad rectangular sclerotized band, more narrow ventrally, setose along its posterior margin with long setae but without any setae on dorsal part of posterior margin and on segment 8, a very narrow band is attached ventrally extending to the base of anterior apophysis, where the band is weakly attached and has a very broad rectangular-shaped base that fits like a segment into segment 8 (Fig. 7b, only visible in fresh preparations); anterior apophysis slightly bent downwards, 3.0× as long as segment 8 dorsally, on basal half of length 2× as broad as at tip, within the first 30% of their length strongly knee-like shaped, on almost the whole length with a deep horizontal graben-like structure; posterior apophysis narrow but with four times broader base, 50% the length of anterior apophysis, with large sclerotized base that is 40% the size of papillae anales in lateral view, posterior apophysis equal in length of dorsal part of segment 8; ductus bursae and corpus bursae are unknown.

Male: unknown.

Diagnosis. *Saalmulleria stumpffi* has by far the largest wing size in Metarbelidae worldwide and its small transparent spot in the forewing near base of M_2 to base of CuA_1 distinguishes it from all other species of *Saalmulleria*. The size of one lobe of the papillae anales is 50% of the size of the whole papillae anales and is at present the largest among Metarbelidae. Remarkable differences to the other species of *Saalmulleria* comprise also the very long

setae along the posterior margin of segment 8 that are absent from its dorsal part, the strongly knee-like shape of the anterior apophyses present on 30% of their length and the very large sclerotized base of posterior apophysis that is 40% the size of the papillae anales.

Distribution. *Saalmulleria stumpffi* is only known from Lokobe, including the Réserve Naturelle de Lokobe (740 hectare in size), located on the southeastern part of the small island of Nosy Be (320 km^2 in size) *ca.* 14 km off the northwestern coast of the main island of Madagascar. The whole area belongs to the "Sambirano Region" and to the "Madagascar Subhumid Forests" ecoregion. *Saalmulleria stumpffi* is classified herein as an endemic species to the "Sambirano Region" and might be restricted today to Nosy Be Island and scattered forest areas nearby located on the "main island" of northern Madagascar. Nosy Be Island has an altitude range of 5–419 m, average annual rainfall is among the highest along the west coast of Madagascar ranging from 2000–2356 mm at Lokobe, with highest rainfall in November–April (White 1983; Hijmans et al. 2005; Reinhardt et al. 2022). Prior to 1300 BP, Nosy Be Island was largely covered by lowland rain forest comprising also genera such as *Podocarpus* L'Hér. ex Pers., but became increasingly a mosaic of grassland, bushland and forest until present due to human activities including the use of fire to destroy forests for agriculture (Reinhardt et al. 2022). The Lokobe forest comprises Leguminosae tree species such as *Parkia madagascariensis* Viguier (Mimosoideae), *Adenanthera pavonina* L. (Mimosoideae) and *Cordyla madagascariensis* R. Vig. (Papilionoideae); other tree species include, *e.g. Croton loucoubensis* Baill. (Euphorbiaceae), *Macphersonia madagascariensis* Blume (Sapindaceae), the extremely rare *Pandanus androcephalanthos* Martelli (Pandanaceae), *Sorindeia madagascariensis* Thouars (Anacardiaceae), one species of *Tambourissa* Sonn. (Monimiaceae) and *Trilepisium madagascariense* DC. (Moraceae) (Birkinshaw 2001; Berry et al. 2017). Pierre Viette took one of the possibly oldest pictures published of this forest in November 1958 (*cf.* Viette 1962, plate III, fig. 6).

Biological traits. The biology of *Saalmulleria stumpffi* is unknown.

Figure 14. Female postabdominal structures of **a.** *Saalmulleria stumpffi* (Saalmüller, 1884), "Type", female, Madagascar, Sambirano Region, Nosy Be Island, Lokobe; **b.** *S. analameranaensis* sp. nov., holotype, female, Madagascar, Western Region, Analamerana Forest, ca. 10 km to 40 km west of the Indian Ocean coastline.

Saalmulleria analameranaensis sp. nov.

https://zoobank.org/893E4235-04E2-46B0-B25D-2E75C3754F74

Figs 4f, 14b

Material examined. Female, ***Holotype***, "Madagascar Nord", "forêt de Analamerana, 50 km S.E. Diego-Suarez" [Analamerana forest, Western region], "alt. 80 m" [altitude 80 m], "29.I. au 3.II.1959" [19th January to 03rd February 1959] P. Viette [Pierre Viette leg.]; genitalia slide number 09/102009 Dr. D. Stüning & I. Lehmann (MNHN).

Description. Female *Head*: rough-scaled; long hair-like scales of brownish-olive mixed with sepia scales on fronto-clypeus; eyes brownish-olive with small black spots; a pair of small rudimentary pits is present on lower fronto-clypeus, a pair of conical projections absent, pits behind labial palpi absent; lower fronto-clypeus is broad, as broad as half of eye-diameter (viewed anteriorly) and smooth, without any structures; labial palpi brownish-olive, very short and small, much less than half of eye-diameter, narrow, consisting of three segments, basal and central segments are of almost equal length, 1st (basal) segment is very broad, 1.3× broader than central segment, rectangular, third segment on top is triangular and *ca.* 85% length of central segment. Antennae bipectinate, narrow and long branches, 4× longer than width of shaft, branches are slightly longer on lower half of antennae and are widely separated at base with 1.5× width of branch, dorsal and lateral sides of branches not scaled, but with many setae in pairs ventrally and laterally, dorsal and lateral sides of flagellum scaled deep olive-buff mixed with brownish-olive.

***Thorax*:** Densely covered with hair-like scales and broader scales of olive-brown with sepia towards tip and cream at tip on patagia and on tegulae, sepia scales on

tegulae with a light lilac glint; scale crest on metathorax is pronounced with long olive-brown hair-like scales with a slightly broader tip of sepia and light cream. Fore and mid legs olive-brown, dorsally sepia, with long dense hair-like structures and a light lilac glint. Epiphyses present, 2.1 mm long, medium broad and flat. Hind legs are missing. Wingspan is 59.0 mm. Forewing length is 28.0 mm, forewing is large, broad with a rounded apex, upperside without any geometric design, deep olive-buff and towards termen with a light golden glint, a simple scale pattern is present, with a large patch of Saccardo's umber at center of forewing from base of R_3 to middle of CuA_1, the patch is not edged inwards by any transparent spot, various terminal, sub-terminal and post-medial patches and bands of Saccardo's umber, but without a prominent broad V-shaped band from apex and costa to near end of CuA_2, the latter vein is not marked in a different colour, termen with weak triangular dark olive lunules, a large sepia patch is present below 30% of length of 1A+2A. Hindwing rounded but with a prominent pointed apex, termen not bent inwards, largely with short scales of deep olive-buff with a light golden glint, with a sepia patch near center of hindwing close to base of M_2, any small transparent spot is also absent as in forewing. Underside with scales of deep olive-buff and cream, the former scales have cream tips, with a light golden glint. Cilia short for such a large species, 1.9 mm long, deep olive-buff with a glint. Forewing venation with strongly sclerotized and broad veins, 1A+2A deeply forked at base, fork is 20% the length of 1A+2A; CuP absent, but still represented by a sclerotized fold on first 2/3 of its length; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separated and initiating from apical angle of posterior cell; M_1 originating from distal margin of median cell and is broadly separated from its anterior angle; R_1+R_2 originating from a long stalk (the stalk has the length of *ca.* 40% of R_3) and initiating from near anterior angle of median cell; R_3+R_4+R_5 are long stalked and originating from anterior angle of median cell, the basal point of this stalk is exactly opposite of the basal point of the stalk of R_1+R_2; Sc more or less parallel to R_1. Hindwing venation with three anal veins, 3A present, 1A+2A present with a fork at base, CuP present; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated, M_2 unusually broadly separated; M_1 and Rs originating from anterior cell, broadly separated, with M_1 at center of distal margin of anterior cell; a short bar from Rs to Sc+R_1 is strongly sclerotized, vein in discocellular cell on both fore- and hindwing is present but not forked distally in forewing. The discocellular cell on forewing and hindwing is small, only *ca.* 20% of wing size. The discocellular cell on the hindwing is similar in shape like a fish-tail, with the upper and lower tip in opposite position, and the upper tip is pointed and bent. Fringe scales short if compared to the large hindwing size, 2.0 mm long, deep olive-buff with a glint. Retinaculum and frenulum absent.

***Abdomen*:** Very long with hair-like scales of deep olive-buff, some with chestnut tips, and a strong light golden glint, upper part of abdomen broadly sepia, end of abdomen broadly sepia, abdominal tuft short, sepia and deep olive-buff. Female postabdominal structure and genitalia with very large, pear-shaped lobes of papillae anales in horizontal position, one lobe 45% the size of papillae anales, lobes ventrally with long setae and few long setae along the edge, each lobe with a long and deep oblique graben-like structure that has no setae at center; papillae anales covered with many short and many long setae. Segment 8 represents a broad rectangular sclerotized band, more narrow ventrally, setose along its posterior margin with very long setae, a narrow band is attached ventrally extending to the base of anterior apophysis; anterior apophysis strongly bent downwards, 2.0× as long as segment 8 dorsally, on basal part at 1/3 of length 2× as broad as at tip, within the first 20% of their length knee-like shaped, on almost the whole length with a deep horizontal graben-like structure; posterior apophysis narrow but with four times broader base, this large sclerotized base is 45% the size of papillae anales in lateral view, posterior apophysis slightly longer than dorsal part of segment 8; ductus bursae is narrow but thickly membranous with a broad pear-shaped structure near its base, the base is not sclerotized; corpus bursae is unknown.

Male: unknown.

Diagnosis. *Saalmulleria analameranaensis* sp. nov. is most different if compared to both other species of *Saalmulleria* in regard to its venation and female postabdominal structure. Segment 8 is the broadest of all three species of *Saalmulleria* with lobes of papillae anales that are not broader than segment 8 dorsally. Additionally, the anterior apophyses are only 2.0× as long as segment 8 dorsally. The very long setae that occur along the entire posterior margin of segment 8 is a common character shared with *S. ampandrandavaensis* sp. nov. However, it can be separated from the latter species by the presence of the broad, thickly membranous pear-shaped structure near the base of ductus bursae. This structure is at present unique to *S. analameranaensis* sp. nov. Noteworthy, the venation on the hindwing has the largest discocellular cell among *Saalmulleria* with *ca.* 20% of wing size in *S. analameranaensis* sp. nov.

Distribution. *Saalmulleria analameranaensis* sp. nov. is only known from Analamerana, including the Réserve Naturelle de la Analamerana (439 km^2 in size, altitude range 10–594 m), located on the northeastern part of Madagascar *ca.* 10–40 km inland from the coast of the Indian Ocean. The reserve is situated on middle Jurassic limestones (172–162 Ma, up to 400 m thick) comprising also deeply eroded karst ("tsingy") that protects some of the remaining forest from human destruction. The whole area belongs to the "Western Region" and to the "Madagascar Dry Deciduous Forests" ecoregion (also Du Puy and Moat 2003). *Saalmulleria analameranaensis* sp. nov. is classified herein as a species that is endemic to the dry forests and dry woodlands of northern Madagascar

and might be restricted today to the forest and woodland patches within and near to the Réserve Naturelle de la Analamerana. The average annual rainfall in this area is *ca.* 1500 mm. The forest and woodland patches of Analamerana have a very high conservation value for the fauna and flora of Madagascar, *e.g.* for lemurs (Mittermeier et al. 2003), and comprise at least 19 species of Papilionoideae (Leguminosae) of which three species are endemic to Analamerana or very restricted and "endangered" , *e.g.* *Phylloxylon decipiens* Baill. and *Millettia nathaliae* Du Puy & Labat (Papilionoideae) (Labat and Moat 2003). The collecting site of the holotype is figured by Viette (1962, plate V, fig. 10) and shows a Dry Forest edge.

Etymology. The species is named for the Réserve Naturelle de la Analamerana on Madagascar ("*Western Region*").

Saalmulleria ampandrandavaensis sp. nov.

https://zoobank.org/4FDFA343-3F58-43F5-A4D4-DB1704FDFE7D

Figs 4g, 15, 16C, E, F

Material examined. Female, ***Holotype***, "Madagascar C." [Madagascar Central Region], "Ampandrandava", "12.XII-1954" [12th December 1954] Dr. E. Diehl [Eduard Diehl leg.]; on a second label: "Museum Paris Don de P. Thiaucourt", genitalia slide number B09/102009 Dr. D. Stüning (MNHN).

Description. ***Head*:** rough-scaled; long hair-like scales of brownish-olive mixed with light olive-cream on fronto-clypeus; eyes brownish-olive with small black spots; a pair of pits is present on lower fronto-clypeus, a pair of conical projections absent, pits behind labial palpi absent; lower fronto-clypeus is broad, as broad as half of eye-diameter (viewed anteriorly) and smooth, without any structures; labial palpi light olive-cream, very short and small, much less than half of eye diameter, narrow, consisting of three segments, basal, central and third segment are of almost equal length, 1st (basal) segment is very broad, 1.5× broader than central segment, rectangular, third segment on top is triangular. Antennae bipectinate, narrow, long branches, 4× longer than width of shaft, branches are slightly longer on lower half of antennae and are widely separated at base with 1.5× width of branch, dorsal and lateral sides of branches not scaled, but with many setae in pairs ventrally and laterally, dorsal and lateral sides of flagellum scaled olive-buff.

***Thorax*:** Densely covered with hair-like scales and broader scales of light brown, tip of all scales is light grey on patagia and on tegulae, some light brown scales at base of patagia and tegulae with a light lilac glint; scale crest on metathorax is pronounced with long olive-brown hair-like scales with a slightly broader tip of light cream. Fore and mid legs olive-cream with scales that have all light grey tips, some scales dorsally sepia, with long dense hair-like structures and a light lilac glint. Epiphyses present, 2.0 mm long, medium broad and flat. Hind legs with two pairs of long tibial spurs, upper pair

Figure 15. Genitalia of *Saalmulleria ampandrandavaensis* sp. nov., holotype, female, Madagascar, Central Region, Ampandrandava, ca. 50 km northeast of Bekily, with a thinly membranous and long ductus bursae (a) and a thinly membranous elongated oval-shaped corpus bursae (b), both without any structures. The two lobes of the papillae anales (c) are in horizontal position, an autapomorphy of species of *Saalmulleria*, and represent the largest lobes among Metarbelidae, with one lobe at least 45% the size of the papillae anales.

narrow and longer, up to 2.1 mm long, spurs in lower pair slightly broader and shorter, up to 1.9 mm long, all spurs with a claw-like tip. Wingspan is 55.0 mm. Forewing length is 24.0 mm, forewing is large, broad with rounded apex, upperside without any geometric design, pale olive-buff mixed with light olive-cream and towards termen with a light golden glint, scales on inner half of forewing with light grey tips, a simple scale pattern is present, with a large rounded patch of sepia at center of forewing from base of M_2 to base of CuA_1, the patch is not edged inwards by any transparent spot, various terminal, sub-terminal and post-medial patches and bands of deep olive-buff, with a prominent broad Y-shaped band from apex and costa to near middle of CuA_1, veins not distinctly marked, termen with weak triangular deep olive-buff lunules, a large sepia patch is present below 25% of length of 1A+2A. Hindwing rounded with prominent pointed apex, termen not bent inwards, largely with short scales of pale olive-buff and light olive-cream with a light lilac-golden glint, without any sepia patch near center of hindwing, but with a weak deep olive-buff terminal band. Underside with scales of deep olive-buff, all scales with light grey tips, with a light golden glint. Cilia are short, 2.0 mm long, deep olive-buff with a glint. Forewing venation with strongly sclerotized and broad veins, 1A+2A

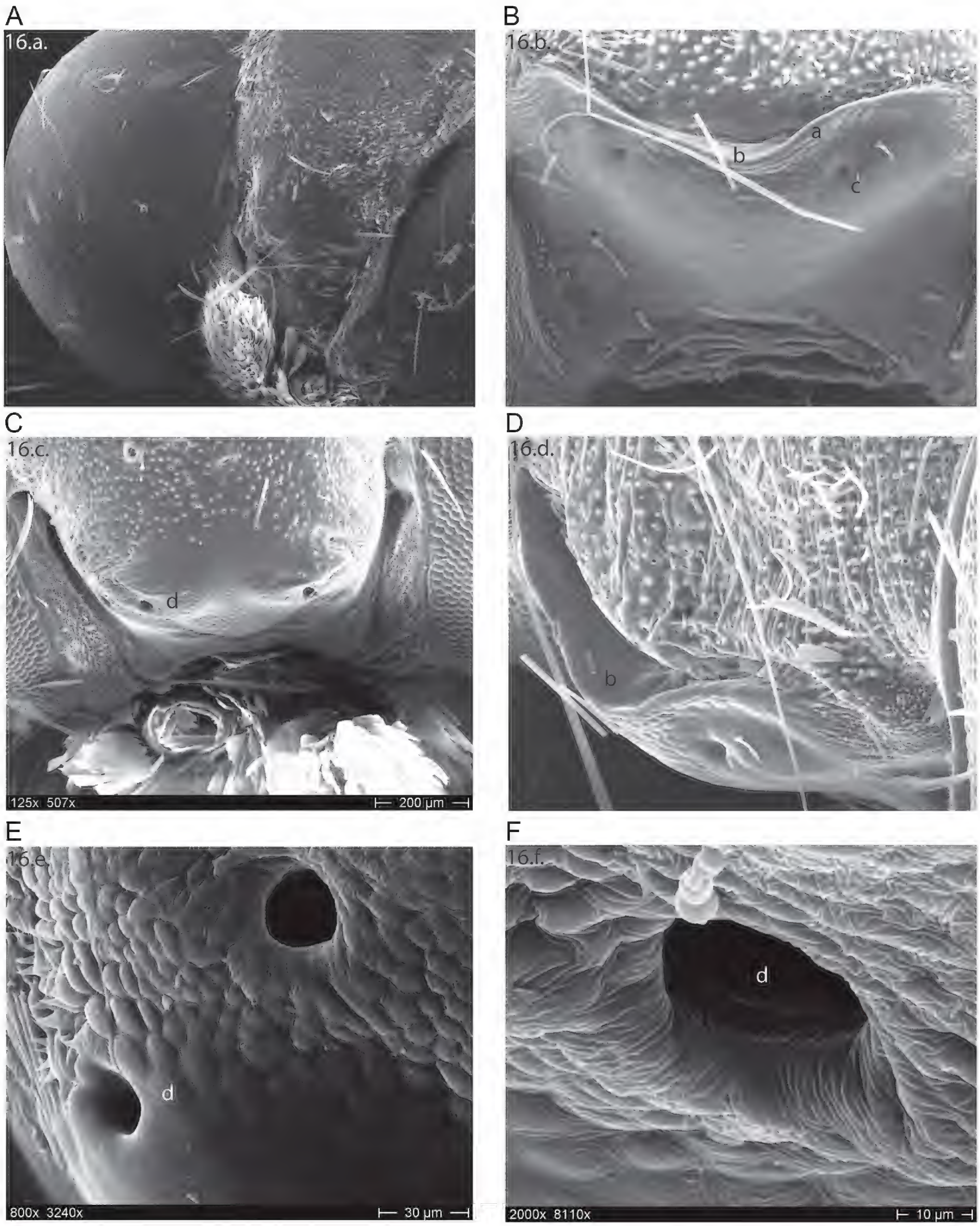


Figure 16. SEM pictures of diagnostic head structures of Metarbelidae from Madagascar: **A.** The lower fronto-clypeus of *Morondavania mineti* sp. nov., holotype, male, is narrow and without a pair of pits as well as without a pair of projections; **B, D.** The lower fronto-clypeus of *Eberhardfischeria husemanni* sp. nov., paratype, female, is broad with a strongly sclerotized plate-like structure (a) with a well-defined dorsal ridge (b) and a pair of rudimentary pits (c); **C, E, F.** The very broad and smooth lower fronto-clypeus of *Saalmulleria ampandrandavaensis* sp. nov., holotype, female, is without any plate-like structure, but with a pair of well-developed pits (d), a variable character in species of *Saalmulleria* that is sometimes entirely absent. A pair of pits on the lower fronto-clypeus is a homoplasy among Metarbelidae in both sexes (*cf.* Lehmann 2019b) and it is in species of various genera a variable character (SEM pictures taken by Karin Ulmen, ZFMK, Bonn 2013).

deeply forked at base, fork is 25% the length of 1A+2A; CuP absent, but still represented by a weak fold on its entire length; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 separated and initiating from apical angle of posterior cell; M_1 originating from distal margin of median cell and is broadly separated from its anterior angle; R_1+R_2 originating from a long stalk (the stalk has the length of *ca.* 30% of R_3) and initiating from near anterior angle of median cell; R_3+R_4+R_5 are long stalked and originating from anterior angle of median cell, the basal point of this stalk is opposite of the basal point of the stalk of R_1+R_2; Sc more or less parallel to R_1. Hindwing venation with three anal veins, 3A present, 1A+2A present but weak and with a fork at base, CuP present, also weak; CuA_2 originating from near hind margin of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated, M_2 broadly separated; M_1 and Rs originating from anterior cell, broadly separated, with M_1 at center of distal margin of anterior cell; a bar from Rs to Sc+R_1 is absent, vein in discocellular cell on both fore- and hindwing is present but not forked distally in forewing. The discocellular cell on forewing and hindwing is small, only *ca.* 15% of wing size. The discocellular cell on the hindwing is similar in shape like a fish-tail, with the upper and lower tip in opposite position, and the upper tip is pointed and bent. Fringe scales short if compared to the large hindwing size, 2.0 mm long, deep olive-buff with a glint. Retinaculum and frenulum absent.

***Abdomen*:** Long with hair-like scales of pale olive-buff and deep olive-buff, with light grey tips, and a strong light golden glint, upper part of abdomen broadly sepia, end of abdomen not broadly sepia, abdominal tuft short, deep olive-buff.

Female postabdominal structure and genitalia with very large, pear-shaped lobes of papillae anales in horizontal position, one lobe 45% the size of papillae anales, lobes ventrally with long setae and few long setae along the edge, each lobe with a long and deep oblique graben-like structure that has no setae at center; papillae anales covered with many short and many long setae. Segment 8 represents a narrow rectangular sclerotized band, more narrow ventrally, setose along its posterior margin with very long setae, a narrow band is attached ventrally extending to the base of anterior apophysis; anterior apophyses slightly bent downwards, 3.0× as long as segment 8 dorsally, on basal part at 1/3 of length 2.5× as broad as at tip, within the first 30% of their length knee-like shaped, on almost the whole length with a deep horizontal graben-like structure; posterior apophyses narrow but with 4.5× broader base, this large sclerotized base is 40% the size of papillae anales in lateral view, posterior apophyses slightly longer than dorsal part of segment 8 but only 30% as long as anterior apophyses; ductus bursae is short with *ca.* 50% length of corpus bursae, broad, membranous, without any broad pear-shaped structure near its base and the base is not broader and not sclerotized; corpus bursae is very large, 4× as large as segment 8 in lateral view, membranous, not sclerotized at any part, without any structures, elongated, oval.

Male: unknown.

Diagnosis. *Saalmulleria ampandrandavaensis* sp. nov. is the smallest species of *Saalmulleria* presented herein. The forewing and hindwing colour is largely pale olive-buff and many pale olive-buff scales on upper- and underside of head, thorax, abdomen as well as large parts of wings have cream or light grey tips. Hence, *S. ampandrandavaensis* sp. nov. represents a lighter coloured species if compared to both other species. The forewing venation has the shortest stalk of R_1+R_2 among *Saalmulleria*, with a length of *ca.* 30% of R_3, but is with 40% much longer in the other species. In regard to the female postabdominal structure, it is most similar to *S. stumpffi*. Various differences exist: first, the very long setae that occur along the entire posterior margin of segment 8 are a common character shared only with *S. analameranaensis* sp. nov. Second, the base of the posterior apophyses is more narrow and elongated, pointing also more upwards than in *S. stumpffi*. Third, the posterior apophyses are only 30% as long as the anterior apophyses in *S. ampandrandavaensis* sp. nov. but half as long as the anterior apohyses in *S. stumpffi*.

Distribution. *Saalmulleria ampandrandavaensis* sp. nov. is only known from Ampandrandava, located in a submontane area *ca.* 100 km to the Southwest of Betroka and *ca.* 50 km to the Northeast of Bekily (*cf.* Viette 1962), at *ca.* 820–1.006 m (24°05'S, 45°42'E) in the "Central Region". To some extent the type locality coincides with the southwestern limit of the central highlands and possibly with the "Madagascar Subhumid Forests" ecoregion. According to Burgess et al. (2004) Ampandrandava might be adjacent to or partly within the "Madagascar Succulent Woodlands" ecoregion. The latter is similar to the Madagascar dry forests but comprises more xerophytic plant species. The authors view about the type locality is supported by a comment of Lees et al. (2003), who noted that Diehl's collecting site at Ampandrandava is located in the "subarid bioclimatic zone". The average annual rainfall in this area is only *ca.* 575–1330 mm. The patches of dry forest and woodlands at Ampandrandava almost certainly have a high diversity of woody Leguminosae, *e.g. Dalbergia pervillei* Vatke (Papilionoideae) (Labat and Moat 2003) with species such as *Croton boiteaui* Leandri and *C. menarandrae* Leandri (Euphorbiaceae) (Berry et al. 2017).

Etymology. The species is named for the type locality Ampandrandava on Madagascar ("Central Region").

Discussion

Evolutionary hypotheses

This paper represents and discusses the only sister-group relationship of Metarbelidae on the African mainland with Metarbelidae on Madagascar based on morphology of undescribed genera and species. Based on this, an evo-

lutionary hypothesis is discussed here: The sister-group relationship of *Shimbania* gen. nov. (termed Gen. Nov. I by Lehmann 2019b) and *Morondavania* gen. nov. (termed Gen.Nov.H) was figured in a dendrogram (*cf.* Lehmann 2019b, Pp. 28, 41, 42), representing a rooted topology for 60 genera, and was discussed together with the history of Madagascar and a driftwood scenario that contributed to the arrival of Metarbelidae from the eastern parts of the African mainland, identified as their ancestral area, before the beginning of the Miocene 23 Ma when marine currents were exclusively westward and are since then unsuitable for dispersal from Africa to Madagascar (Lehmann 2019b, Pp. 326–328). Hence, the stem lineage representatives of all species from Madagascar herein are older than 23 Ma with a maximum age of 83 Ma (Lehmann 2019b, p. 327), the time when eastern Madagascar was completely isolated from India and the Seychelles; no link has been found to the Metarbelidae of the Oriental Region (Lehmann 2019b). On the African mainland, the Eastern Arc Mountains with several type localities of *Shimbania* were uplifted *ca.* 30–25 Ma. Until 25 Ma the lowland rainforests of Congolia became increasingly separated from coastal forests in Somalia, Kenya and Tanzania due to a drier climate and geological instability in the latter areas (Axelrod and Raven 1978; Maley 2001). Based on further detailed morphological studies of more than 300 species by I.L. since 2019, bringing the total up to more than 700 species, no additional evidence of any sister-group has been found on the African mainland and no evidence has been found that any sister-group of Metarbelidae on Madagascar exists in the Oriental Region.

Lehmann (2019b) presented seven plesiomorphic characters for basal Metarbelidae. Based on these plesiomorphies, *Shimbania nigeriaensis* sp. nov. is a younger species among *Shimbania* due to the occurrence of only one pair of tibial spurs to the hindleg which is an apomorphic character in *Shimbania*. This disjunct record in coastal Central Africa could be explained with the evolution of the stalked condition of R_1+R_2, that occurs in a well visible length in the forewing of all species presented herein, and evolved possibly together with the heavy uncus in the drier transition zones adjacent to the lowland rainforest on the African mainland, *e.g.* in the Guinea-Congolia/Sudania regional transition zone (Lehmann 2019b). This view is supported by the fact that in more than 700 species, if compared to the species herein, apomorphies are absent that evolved in species of genera that only occur in lowland and submontane rainforest of the Guineo-Congolian Region on the African mainland as well as in lowland and submontane rainforest of the Oriental Region. Such apomorphic characters comprise for Metarbelidae, *e.g.* in males, in general a more complex genitalia with long strongly sclerotized appendices on various parts of the semi-transtilla and/or valvae, a large thinly membranous vertical flap-like structure extending outwards of the vinculum and above the aedeagus (only visible in fresh genitalia), strongly sclerotized long spoon-like or stick-like appendices on valvae while the outer half of valvae is thinly membranous, and/or many dominant and very long sclerotized setae that occur equally on various parts like uncus, tegumen and valvae; in females, all parts of the postabdominal structure are equally strongly sclerotized and more complex, *e.g.* with large plates on the ventral part, and/or a long sclerotized base on the ductus bursae occurs, and/or anterior and posterior apophyses are dominant, such as very broad (*cf.* Lehmann 2019a, b). It is noteworthy, that none of those apomorphies occurs in any reduced form in any species presented herein and that no species represents basal Metarbelidae; the latter occur only close to or to the South of the Zambezi River (*cf.* Lehmann 2019b). These morphological facts support the assumption that all species herein are neither evolved in rainforests nor in the Afromontane Region, but in drier Lowlands. Species of *Saalmulleria* recorded on Nosy Be Island in the humid forests of the Sambirano Region as well as in orographic rainforest of the Eastern Region to the North of Sambava, should have stem lineage representatives that first evolved in drier lowland and/or submontane habitats on Madagascar. Hence, the stem lineage representatives of species like *Shimbania nigeriaensis* sp. nov. and *Saalmulleria* migrated later into lowland rainforests, namely from drier habitats located adjacent to rainforests. The former evolved on Madagascar later than on the African mainland and only during the late Eocene/early Oligocene which means between 38–23 Ma with rainforests of the Sambirano Region as the youngest biome on Madagascar; on the latter, arid conditions with dry-adapted forests and woodlands largely preceded humid forest conditions (Wells 2003). Hence, it is very likely that the stem lineage representatives of all species herein are much older than 38 Ma and evolved first not only on the African mainland before the Eastern Arc Mountains were uplifted, but also evolved first in drier habitats also on Madagascar. Species of *Shimbania* possibly migrated from drier areas to the North of the Congo Basin towards the eastern coast of Africa and further southwards with a few hundred kilometers inland from the Indian Ocean. This assumption is supported by data on the stalked condition of R_1+R_2 which is not only absent in all Metarbelidae from the Oriental Region and on the Arabian Peninsula but also from all rain forest taxa as decribed above and from 102 studied species in more than 15 genera occurring only in the Congo Basin (as figured by Burgess et al. 2004, fig. 4.15.), except from areas that border the Congo Basin in the Northwest near Douala, in the North with a record from Dili (HRH Prince Leopold III leg.) and from Niarembe in the Northeast. There is no record on the stalked condition of R_1+R_2 in any species occurring close to the southern edge of the Congo Basin. To the North of the Congo Basin species with a stalked condition of R_1+R_2 occur mainly in the Guinea-Congolia/Sudania regional transition zone or further to the North. In all those species the genitalia is not only very different but also the stalked condition of R_1+R_2 is reduced, the fork is very narrow and often difficult to see (*cf.* apomorphies 6, 7 and 8 on forewing in Lehmann 2019b).

Conservation implications

Species of *Shimbania* are rare. This fact is supported by long-term and extensive field work in coastal Kenya by I.L., *e.g.* in various forest and non-forest habitats close to the Shimba Hills, near Buda Forest, Shimoni Forest and Shimo la Tewa. All species of *Shimbania* occur in isolated small forest patches and some type-localities might be already destroyed by humans, *e.g.* in Shimo la Tewa, in the Kaguru Mountains and Pugu Hills (Tanzania), near Hluhluwe and Durban (Republic of South Africa). Due to a sedentary behavior of species of *Shimbania*, and due to the isolation of their habitats, the gene flow between still existing populations is not only interrupted at present, but it will also last for all time in the future because of an increasing human population combined with an increasing climate change resulting in more forest isolations, degradations and destructions. This interruption of gene flow may cause an irreversible genetic divergence not only for all species of *Shimbania*, but also for all species on Madagascar.

Metarbelidae were probably once common and widespread on Madagascar supported by the fact that the large majority of woody species of Leguminosae (*cf.* Material and methods) still occur in drier habitats. For example, if the Metarbelidae fauna of Madagascar is compared to present-day Kenya, which was once attached via the Lamu area and Tana River Delta to the westernmost angle of Madagascar *ca.* 145 Ma, and has a similar size to Madagascar today. At least 126 Kenyan species occur in 41 genera (Lehmann in prep.). This comparison, based on the similar country size, shows that the Metarbelidae fauna on Madagascar is at present very poor in species, supported by the fact that no Metarbelidae was recorded by well experienced Lepidopterists' that collected thousands of other Lepidoptera specimens on Madagascar like Dr. Albert Legrain (pers. comm. to I.L. in 2008).

The possible extinction rates are higher on Madagascar where the landscape began drastically to change with a major transformation caused by several human activities, *e.g.* too frequent burning, too short timber-harvest cycles and climate change, *e.g.* aridification prior to human arrival, in particular during and shortly before the last 2000 years with a transformation beginning first in the drier areas (Burney 2003) and hence, causing possibly high extinction rates among Metarbelidae with a loss of entire monophyletic groups including the stem species and all its descendants. If so, this can be one explanation for the present-day poor diversity of Metarbelidae on Madagascar in drier as well as rainforest habitats.

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Appendix 1

Notes on the etymology of the "Shimba Hills":

The Shimba Hills (120–447 m and *ca.* 4°09'S–4°21'S and 39°16'E–39°30'E) are located *ca.* 23 km southwest of Mombasa, *ca.* 9 km west of Kaya Muhaka (*cf.* Lehmann and Kioko 2005) and *ca.* 15 km inland from the Indian Ocean coastline.

The origin and meaning of the word "Shimba" is unknown. It might have been given to the area by one of the chieftains or Sultans of Vumba Kuu who were called "Mwana Chambi" until 1544 A.D. The Missionary Wakefield (1870), by then working at Mombasa, mentioned the "Shimba mountain" on his way from Mombasa to Dhaicho and stated, that this "… long mountain … is occupied by various tribes of Wadigo and other Wanyika tribes …" [including maybe the Digiri and Wasi as possible aboriginal inhabitants]. The WaDigo occupied this area already before 1204 A.D. (Hollis 1901) and their Kayas, like Kinondo, must be of a similar ancient age like the Kaya names. The languages of the WaNyika are closely related to KiDigo but all are little studied (Dammann 1958). According to the former District Commissioner Eric Risley (1966) "Shimba" means "lion" in KiDigo; a statement that is not correct. Among a handful of scientists with great knowledge on KiDigo, the late Ernst Dammann, who also dealt in detail with WaDigo tales of various content that he collected mainly during 1933 and 1935 in East Africa, *e.g.* near Mombasa, mentioned only the word "mwenetsi" for "lion" in his notes, *e.g.* in 1958. The word "Shimba" does also not appear in any context to WaDigo history dealt with in several publications by various authors of the early 20th century. According to the facts, that various tribes once lived in the Shimba Hills during the 19th century and much earlier, and that their languages are little studied, it is very unlikely that "Shimba" could be a corrupted version of the KiDigo "Shambe" that means "Sable antelope" ("*mnyama kama*" in KiSwahili) according to Glover (undated) and Mangat (2021); both authors are most probably incorrect in their statements.